October 1945

WIRE AND WIRE PRODUCTS

performance

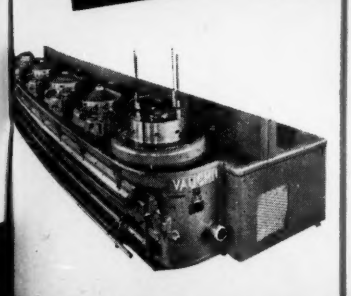
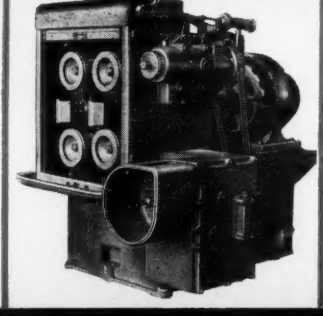
Performance is the quality that pays production dividends in Vaughn Wire Drawing Machinery . . . performance that is fast, safe, versatile, dependable! Let *performance* be your guide in selecting equipment for your current wire drawing needs.

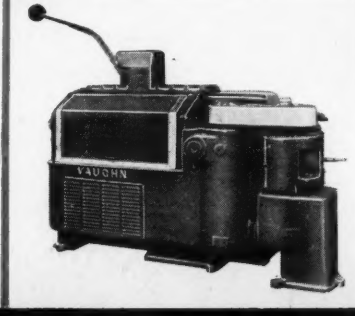
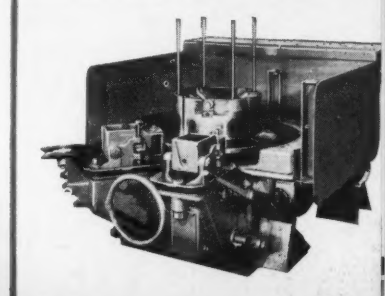
VAUGHN
WIRE DRAWING MACHINERY

See pages 732 A-D

THE VAUGHN MACHINERY CO.
CUYAHOGA FALLS, OHIO

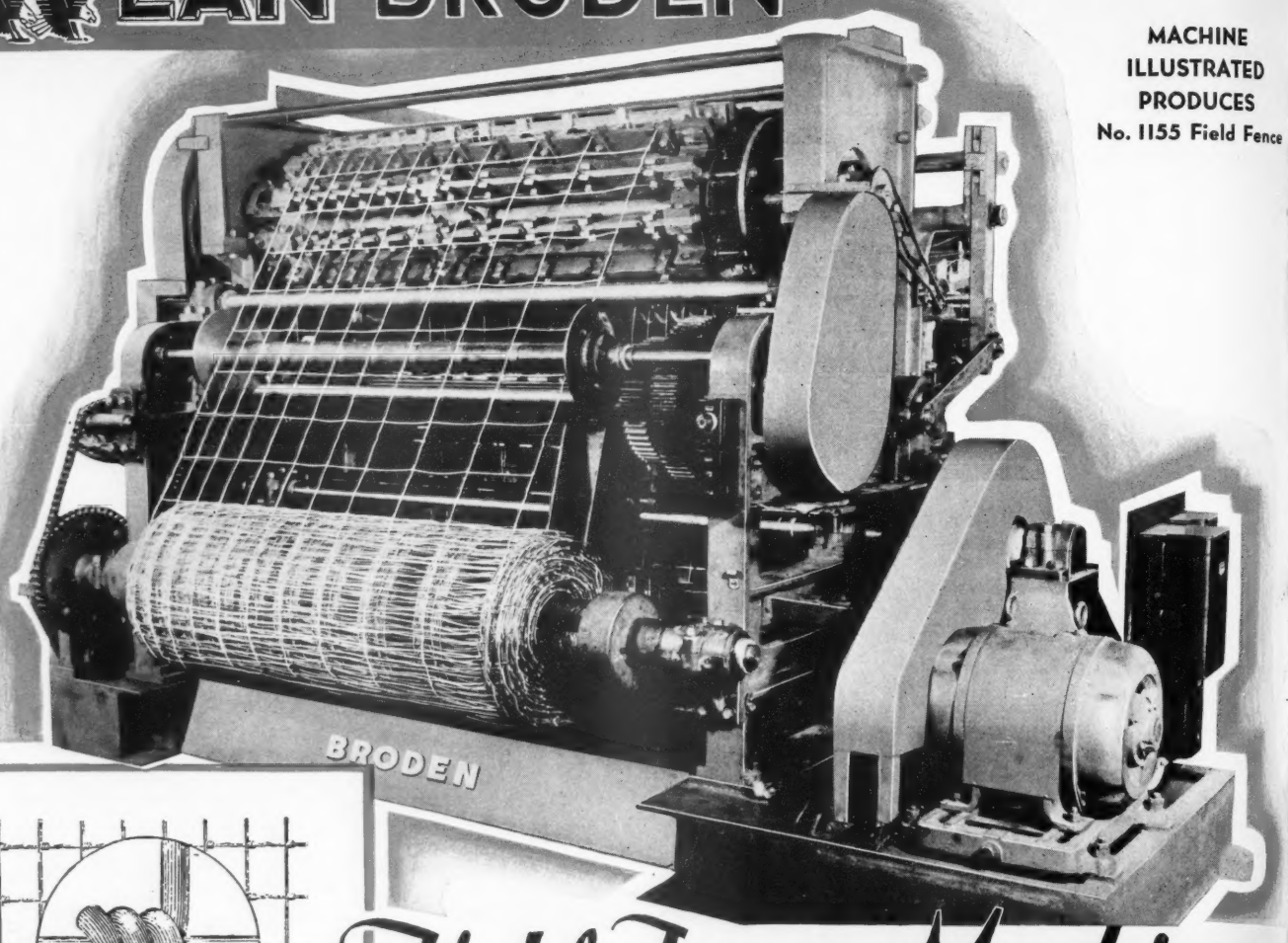
COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

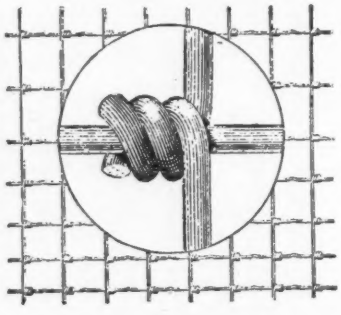



OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

WEAN-BRODEN



MACHINE ILLUSTRATED PRODUCES
No. 1155 Field Fence



Field-Fence Machines

(IMPROVED HOLMQUIST TYPE)

THESE machines are faster, require less maintenance and are available for making all types of farm fences, cattle and sheep fences, poultry and garden fences, according to U. S. Department of Commerce Recommendations. . . . All machines are arranged for individual motor drive; working parts are of high grade tool steel, and many noteworthy improvements are incorporated to make better fence at highest production rate.

COLD ROLLING MACHINERY

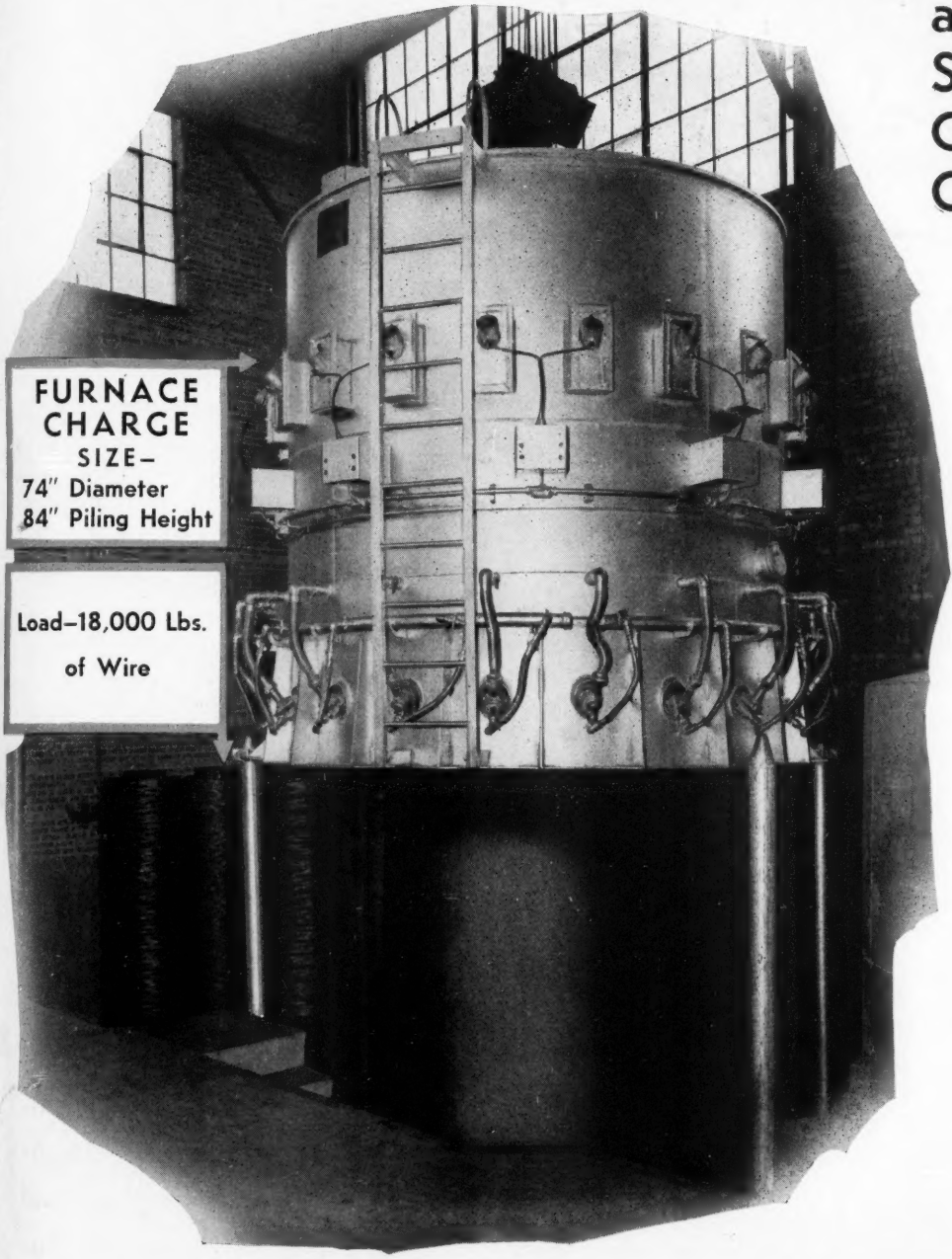
For 36" Wide Material and Narrower
Mills • Reels • Slitters • Levelers • Coilers
Edgers • Scale Breakers • Shears • Scrap
Ballers • Continuous Pickling

WIRE MILL EQUIPMENT

Wire Drawing Machines • Patenting • Galvanizing and Tinning Take-Up Frames
Wire Flattening • Spoolers • Nail Galvanizing and Blueing Units • Barb Wire
Machines • Bale Tie • Poultry Netting

The BRODEN CONSTRUCTION Co., Inc., Cleveland, O.
A SUBSIDIARY COMPANY OF
The WEAN ENGINEERING Co., Inc., Warren, O.

This WILSON BELL TYPE *Furnace* IS BEING LOWERED OVER ANOTHER HEAVY CHARGE at the WILSON STEEL & WIRE COMPANY'S Chicago Plant.



SINCE this installation was made, 8 additional units have been ordered by other wire producers.

THE highest yield per hour at the lowest fuel rate–

Average Load–18,000 Lbs.

Average Time–8 Hours.

Average Fuel Rate–
1,100,000 BTU Ton.

The Wilson Annealing Unit is covered by Patents Nos. 1,952,402, 2,068,477, 2,078,356, 2,081,612, 2,089,843, and other patents pending.

ENGINEERED AND CONSTRUCTED BY THE

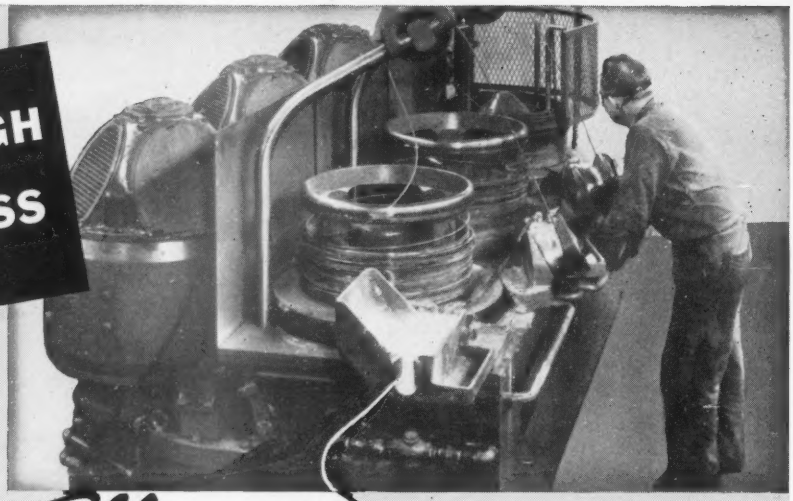
Lee Wilson ENGINEERING Co., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES ★ RADIANT TUBE HEATING ★ HEAT TREATING PROCESSES

GOOD THROUGH THE *LAST* PASS



Magnus

52C-1

For High Carbon Wire

Magnus 52C-1 offers considerable improvements in drawing speed on any difficult draws where the problem of effective carry-through on multi-pass operations is causing trouble. Developed particularly for high carbon wire, it is also in extensive use on stainless steel and other alloy wires and on bolt and rivet stock.

Its outstanding feature is its ability to carry through for the entire series of passes in multi-pass work at speeds which are impossible for ordinary lubricants.

Magnus 52C-1 is used either straight in the die box or mixed with lime up to 50% lime content, depending on the nature of the draw. It will pay you to look into the improved speed and die life offered by Magnus 52C-1. Many users have commented, also, on the brighter finish and lack of scratches after using this lubricant.

Special Compounds to Meet Your Needs

Magnus has always specialized in producing "tailor-made" wire drawing lubricants to solve dificult individual drawing problems. If you are anxious to obtain improved results on any particular drawing operation, let us know the details and we will work out a special material for you.

MAGNUS

MAGNUS CHEMICAL CO., 188 SOUTH AVE., GARWOOD, N. J.

Wire Drawing Compounds

If you examined the cross-section of a piece of bethanized wire through a high-powered magnifying glass, here's what you would see: a sinewy inner core of steel, encased in a smooth, uniform coating of bright zinc.

It's no accident, this remarkable uniformity of the bethanized coating. The coating, of 99.9 per-cent-pure zinc, is applied by an advanced electrolytic process which forms a perfectly uniform coating around the entire circumference. And so tightly is the coating locked to the steel that the two metals become virtually one.

Best way to prove the tightness and ductility of the bethanized coating to your own satisfaction is to give it some punishment. Take a piece of bethanized wire—any length. Then bend or twist it, wrap it around its own diameter, or draw it down to fine gauge. The coating won't be loosened in any way.

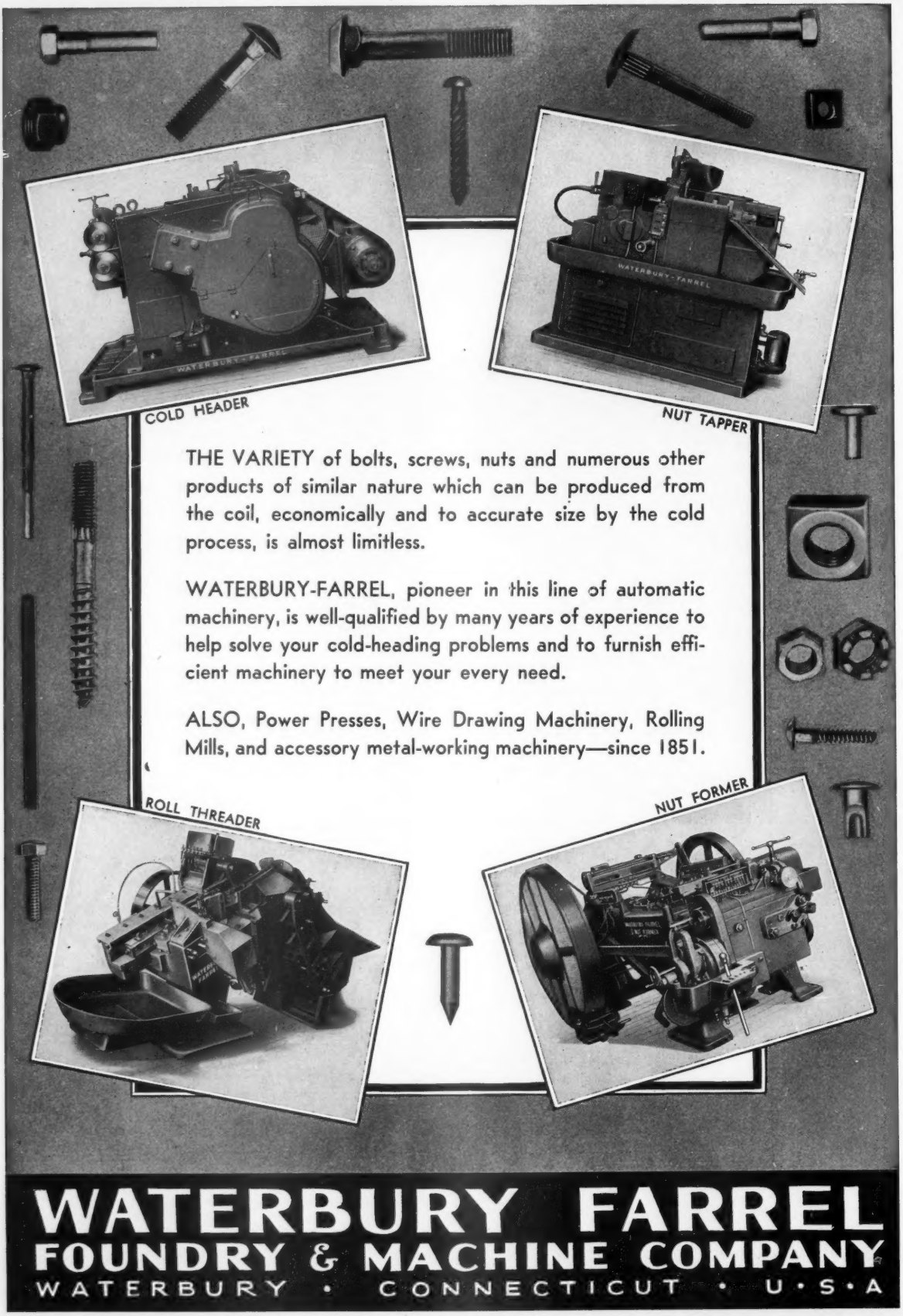
What about corrosion-resistance? Bethanized wire resists corrosion so stubbornly because of the high purity of the coating and the absence of thin spots in the smooth, uniform coating. Where exceptional resistance to corrosion is required, it is possible to apply bethanized coatings in weights up to three times as heavy as those specified in conventional Type 3 galvanizing.

Why don't you give bethanized wire a workout at your first opportunity? Test it thoroughly, then decide for yourself. For all the details, write to the nearest Bethlehem district office. Or address Bethlehem Steel Company, Bethlehem, Pa.

Bethlehem Steel Company, General Offices, Bethlehem, Pa.

★ BETHLEHEM STEEL ★

BETHANIZED WIRE



THE VARIETY of bolts, screws, nuts and numerous other products of similar nature which can be produced from the coil, economically and to accurate size by the cold process, is almost limitless.

WATERBURY-FARREL, pioneer in this line of automatic machinery, is well-qualified by many years of experience to help solve your cold-heading problems and to furnish efficient machinery to meet your every need.

ALSO, Power Presses, Wire Drawing Machinery, Rolling Mills, and accessory metal-working machinery—since 1851.

WATERBURY FARREL
FOUNDRY & MACHINE COMPANY
WATERBURY • CONNECTICUT • U·S·A

WIRE & WIRE PRODUCTS, Vol. 20, No. 10, October, 1945. Executive Office, 300 Main St., Stamford, Conn. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S Spengel, Sec. and Treas. Publication office, 206 Summer St., Stamford, Conn. Subscription price: U. S. $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign $7.50 per year. Entered as second class mail at the Post Office, Stamford, Conn., Feb. 9, 1945, under Act of March 1879.

The Last Word in Industrial Furnaces

● Present-day conditions—changing production programs and reconversion—call for more efficient new furnaces and for bringing old furnaces up to F. E. I. standards.

Performance records on F. E. I. equipment, in important installations, are available for your inspection and show better quality, higher production and greatly reduced cost per ton for the following types of equipment:

Direct Fired Cover Annealing Furnaces (for coiled strip, tin plate, flat sheets, wire and rod). Also for spheroidizing, normalizing and bright annealing.

Galvanizing, Patenting, Lead Annealing and Salt Bath Furnaces for the wire industry.

Galvanizing furnaces for pipe, sheet and jobbing plants.

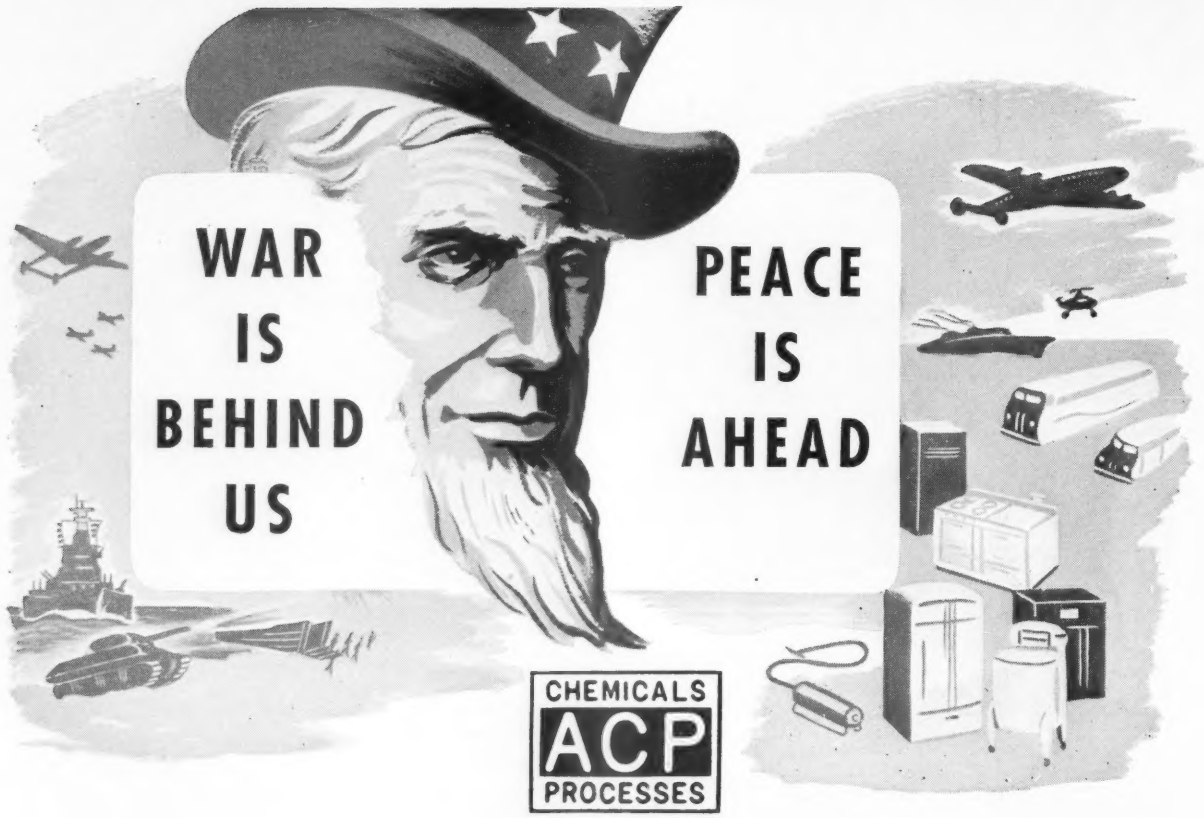
***Conversion* of existing Cover Annealing Furnaces to F. E. I. Direct Fired System.**

Let us help you apply advanced F. E. I. principles to your next furnace job. Write for complete information today.

FURNACE ENGINEERS, *Inc.*

Specializing in the design, manufacture and installation of furnaces for the metal working industries

1551 WEST LIBERTY AVENUE ★ PITTSBURGH, PA.



ACP Products that helped win the war are now available to the metal-working industry as it resumes output of peacetime products — some essential, others which will again add comfort and pleasure to our American way of living. A partial list of these ACP products follows:

Rodine saved millions of gallons of acid and untold tons of steel when steel output was a critical item in World War production. Rodine in the pickle bath prevents needless waste of acid and metal by confining the action of the acid to the removal of scale.

Cuprodine produces a bright, adherent copper coating on steel — without current. Cuprodizing improves drawing, reduces pickup and increases die life.

Cuprotek retards corrosion of copper and its alloys.

Actalyte provides a rapid and efficient method for complete removal of copper coatings.

Non-Electrolytic Acid Pickle Polish Process produces a lustrous polish on type 302 (18-8) stainless steel by use of chemicals instead of mechanical processes or the use of current.

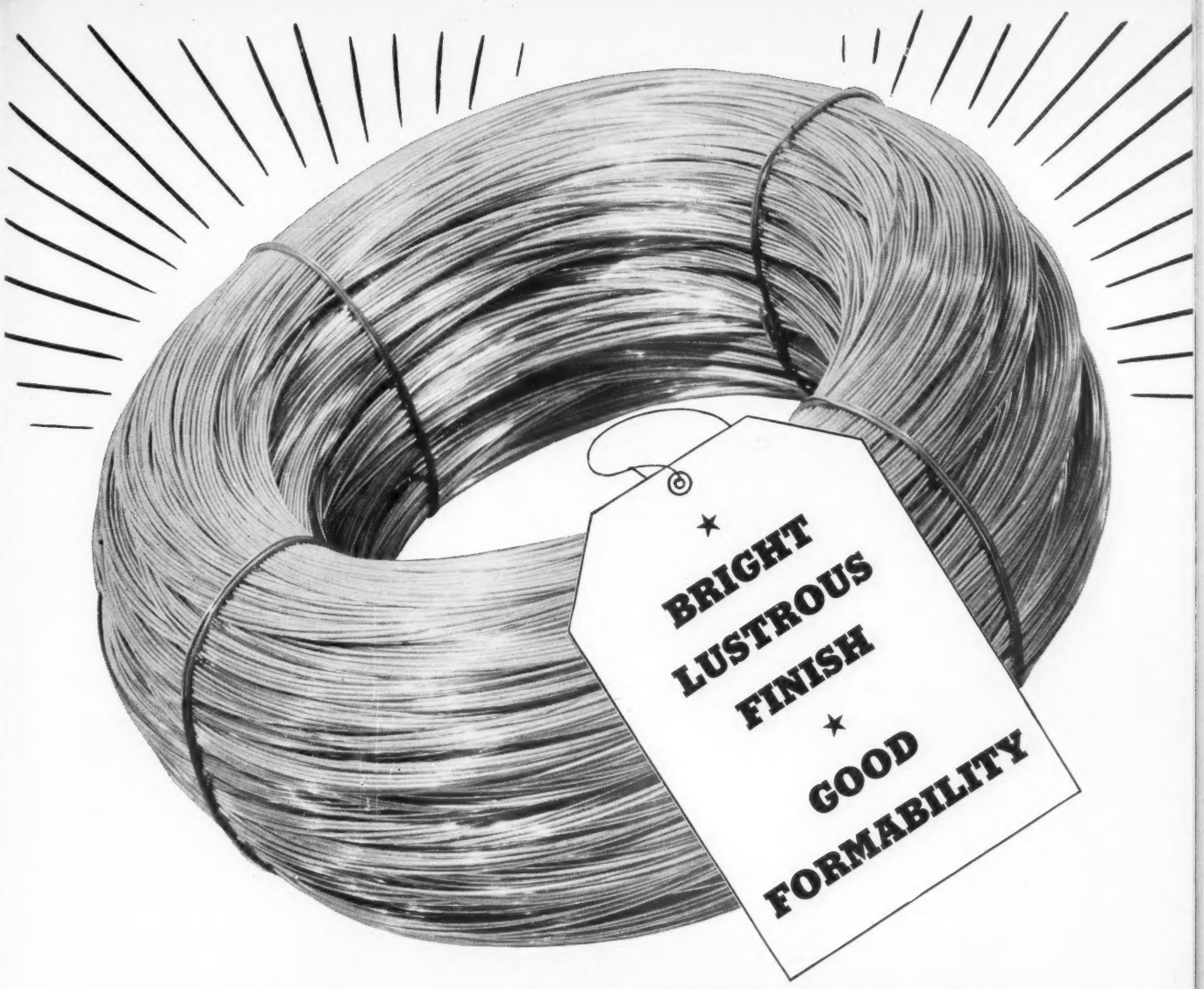
ACP has served the metal-working industry through two World Wars and the intervening years of peace. This experience in inhibiting pickle baths and other application of chemicals to the industry is available to you to help speed your reconversion to normal production.

Our Technical Department will gladly assist you in the most effective application of our products to your manufacturing requirements. Write Dept. D-10.

MANUFACTURERS OF INHIBITORS AND METAL WORKING CHEMICALS

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP PENNA.

Note—West Coast Plants may address inquiries and orders for prompt delivery to Leon Finch, Ltd., 728 East 59th St., Los Angeles, California.



NEW CONTINENTAL *kokote* WIRE

TRADE MARK REG. U.S. PAT. OFF.

● An entirely different kind of galvanized steel wire is Continental's new KOKOTE. You have to see it to believe a galvanized coating can be so silvery bright and lustrous. New KOKOTE is produced by a special Continental process. It has a desirable degree of stiffness. Made in sizes from 18 to 28 gauge to adapt it to a wide range of applications. The wire is carefully selected open hearth steel produced in Continental's own furnaces. Furnished in coils, and on spools and paper cores. You are invited to write, describe your wire requirements, and receive a sample of new KOKOTE.

CONTINENTAL SUPERIOR STEEL

CONTINENTAL STEEL CORPORATION

GENERAL OFFICES • KOKOMO, INDIANA

PRODUCERS OF *Manufacturer's Wire* **in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.**

WINCO

for magnet wire products that must do the job!

ENAMELED COPPER
ENAMELED IRON
ENAMELED ALLOY
ENAMELED ALUMINUM
TWISTED MULTIPLES
PARALLEL MULTIPLES

SILK COVERED
COTTON COVERED
CELANESE COVERED
GLASS FIBRE COVERED
LITZENDRAHT AND
SPECIALS TO ORDER

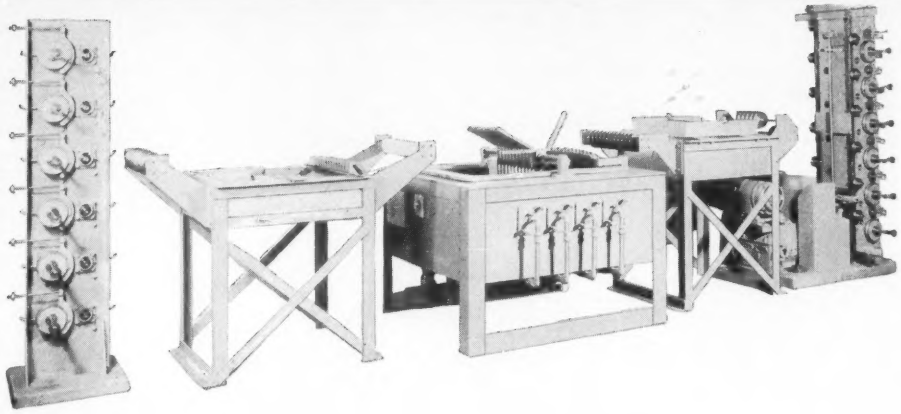
There's more to present day engineering and design problems than shortages of materials, priorities, etc. There is also the question of whether specifications have been rigidly adhered to. Wire, for example, must meet such requirements as specific electrical properties, flexibility, tensile strength, laying speed, uniformity, etc.

Whether it's a buyer's or seller's market, WINCO magnet wire products are drawn to exact specifications. Uniformity of product is guaranteed by mercury process tests and careful supervision guards against variations in consistency, structure or electrical values.

If you have a wire problem, our complete facilities are at your disposal. Send blueprints or specifications for recommendations, without obligation. Samples sent on request; write today.

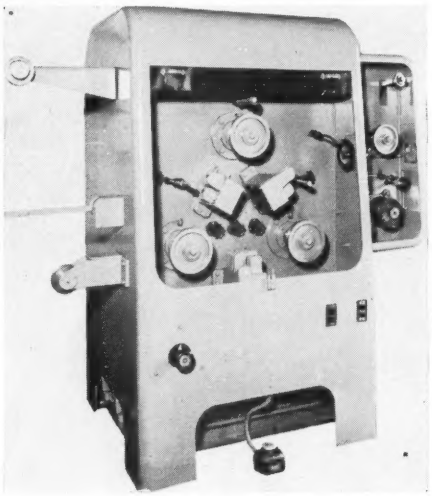
WINSTED DIVISION

WINSTED HUDSON WIRE COMPANY CONNECTICUT



WIRE TINNING OUTFITS

Also Horizontal Takeups and Let-offs supplied for larger size wires and accommodating larger reels.



HIGH SPEED
WIRE DRAWING MACHINE
for Intermediate and Fine Wire

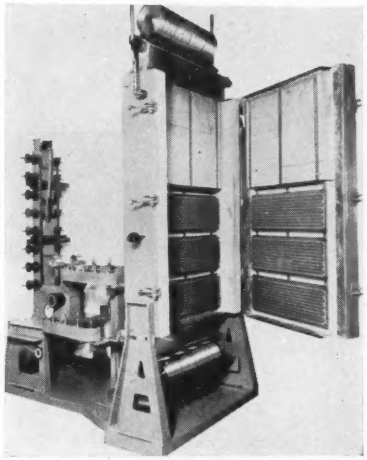
FULL LINE OF WIRE ENAMELING MACHINES

EST. 1855 INC. 1915

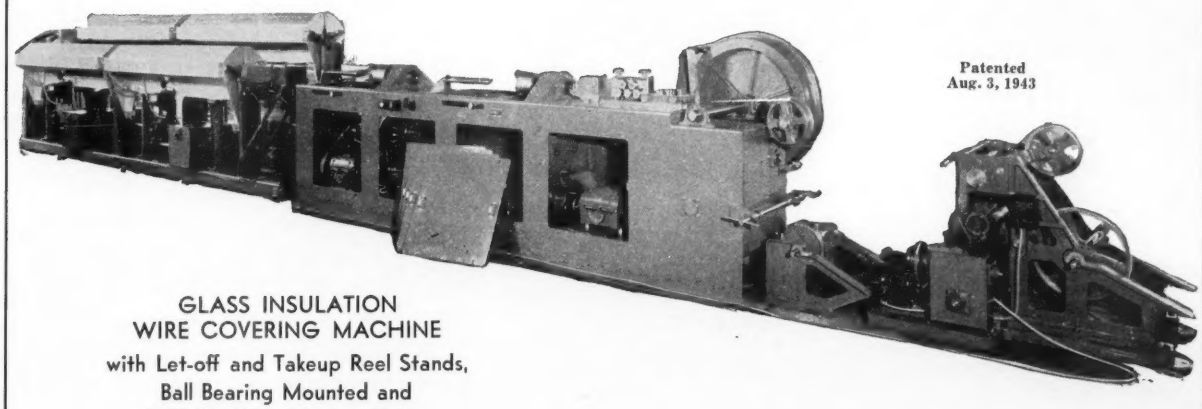
"American"
INSULATING
MACHINERY
COMPANY

517 WEST HUNTINGTON ST.
PHILADELPHIA PENNSYLVANIA U.S.A.

COMPLETE LINE OF WIRE INSULATION WINDING MACHINES



S-16 Medium Wire Enameling Machine,
Ball-bearings and Motor Drive,
Other models for heavier wires.
Lacquering Outfits and Synthetic Applicators.



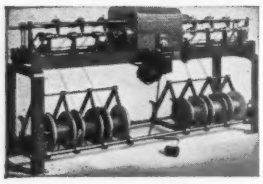
Patented
Aug. 3, 1943

GLASS INSULATION
WIRE COVERING MACHINE
with Let-off and Takeup Reel Stands,
Ball Bearing Mounted and
Variable Speed Motor Drive,
Baking Ovens with Two Coat Varnish Applicators,
and Individual Automatic Temperature Controllers.

Let us confer with you on your wire machinery problems.

* **SYMBOL**

Fast, accurate, uniform winding with FIDELITY Wire Spooling Machines



**Felis Fortis*, a fitting companion to the Lion of Lucerne, this lion is one of two which guard the entrance to the world-famous Mariners' Museum near Newport News. The skilled chisel of the sculptor has endowed the granite with vitality and a living sense of strength, speed and control.

With one of these FIDELITY Machines, you wind every spool, stick, tube or quill of wire at high speed and get an even lay of wire in units of unvarying length and weight.

This precise and accurate control is important in its ultimate economy, whether applied to wire packaging or to producing units where length, weight, spacing, taper or other mechanical tolerance limits affect performance.

FIDELITY Wire Spooling Machines are made in a variety of types and sizes to take care of practically all kinds of precision winding operations. All are simple to operate with the minimum attention and power consumption. Equipped with automatic yardage meter, automatic stop-motion and change gears for different wire spacing, they are versatile, serviceable machines that turn out a uniformly neat package or unit for you — economically and quickly.

Write for special bulletin on FIDELITY Wire Spooling Machines.

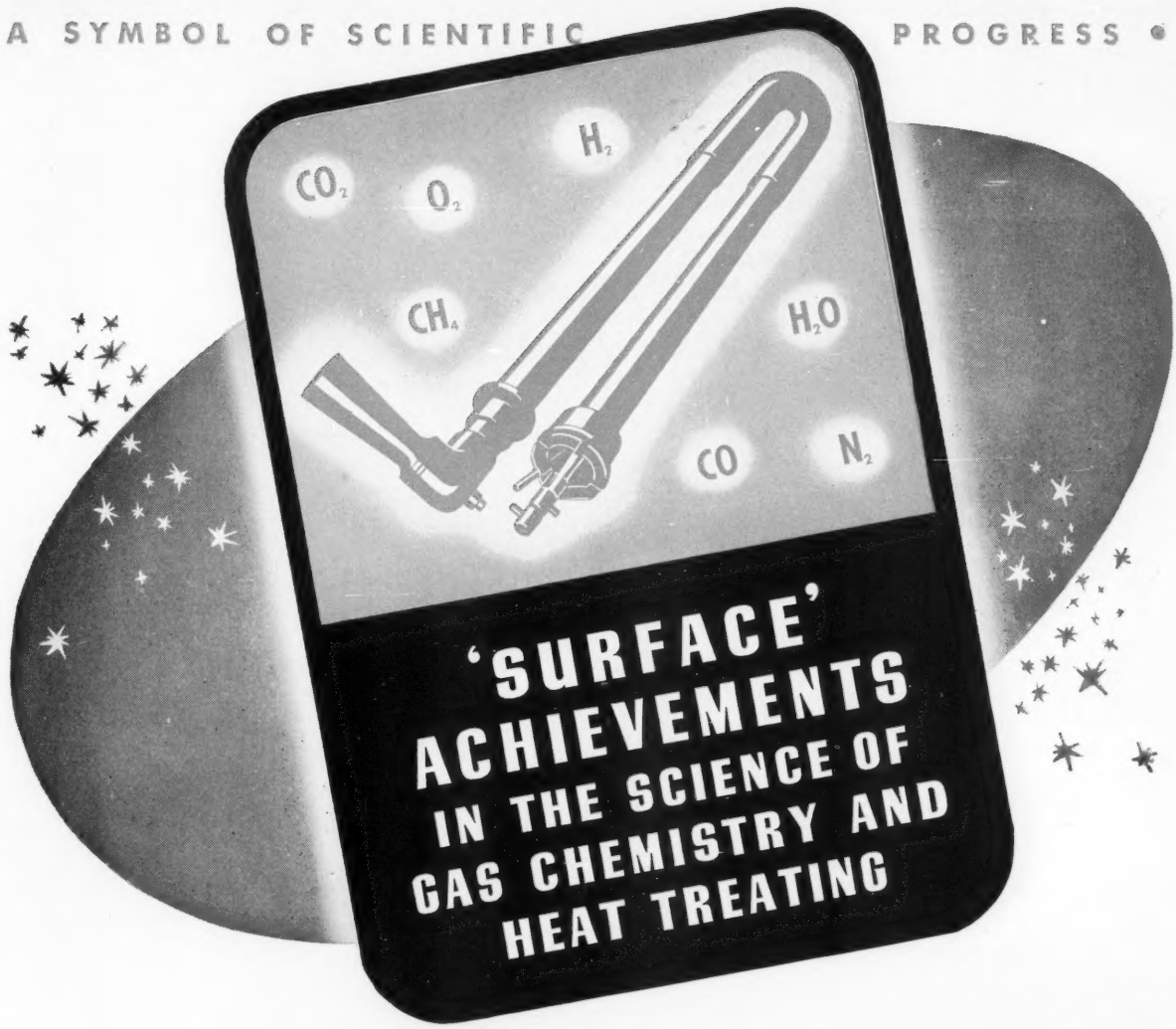
MANUFACTURERS OF CIRCULAR KNITTING MACHINES

BUILDERS OF AUTOMATIC PRECISION MACHINES

FIDELITY MACHINE COMPANY

★ **3908-18 FRANKFORD AVENUE, PHILADELPHIA 24, PA.**

A SYMBOL OF SCIENTIFIC PROGRESS



'SURFACE' ACHIEVEMENTS IN THE SCIENCE OF GAS CHEMISTRY AND HEAT TREATING

- Gas Carburizing and Carbon Restoration (Skin Recovery)
- Clean and Bright Atmosphere Hardening
- Bright Gas-Normalizing and Annealing
- Dry (gas) Cyaniding
- Bright Super-fast Gas Quenching
- Atmosphere Malleableizing
- Atmosphere Forging
- Specific Effects upon Metal Surfaces

'Surface'

ARMY E NAVY

STANDARD AND SPECIAL INDUSTRIAL FURNACE EQUIPMENT FOR:

Forging, Normalizing, Annealing, Hardening, Drawing (Direct-fired and Convection), Carburizing, Nitriding and Heating. Special Atmosphere Generators. *Write for bulletins.*

SURFACE COMBUSTION CORPORATION · TOLEDO 1, OHIO

"Steelskin Brands"

Reg. U. S. Pat. Office

WIRE, TUBING, STAMPING
DEEP DRAWING SOAPS AND COMPOUNDS

✦ ✦ ✦

SPECIAL DRY AND WET WIRE DRAWING SOAPS AND COMPOUNDS FOR

High Carbon	**Tool Steels**
Low Carbon	**Spring Wire**
Copper	**Coat Hanger Wire**
Brass & Bronze	**Stainless Steel**

And Many Other Types of Wire.

Back of the **"STEELSKIN" TRADE MARK** is a Thirty-Five Year Period of Experience in the Development and Manufacture of **Soaps and Compounds** for Dry and Wet Drawing of all Types of Ferrous and NonFerrous Wire.

Our Engineers Will Be Glad to Co-operate With You in Finding the Most Economical and Efficient Solution to Your Drawing Problems.

Please Write or Telephone

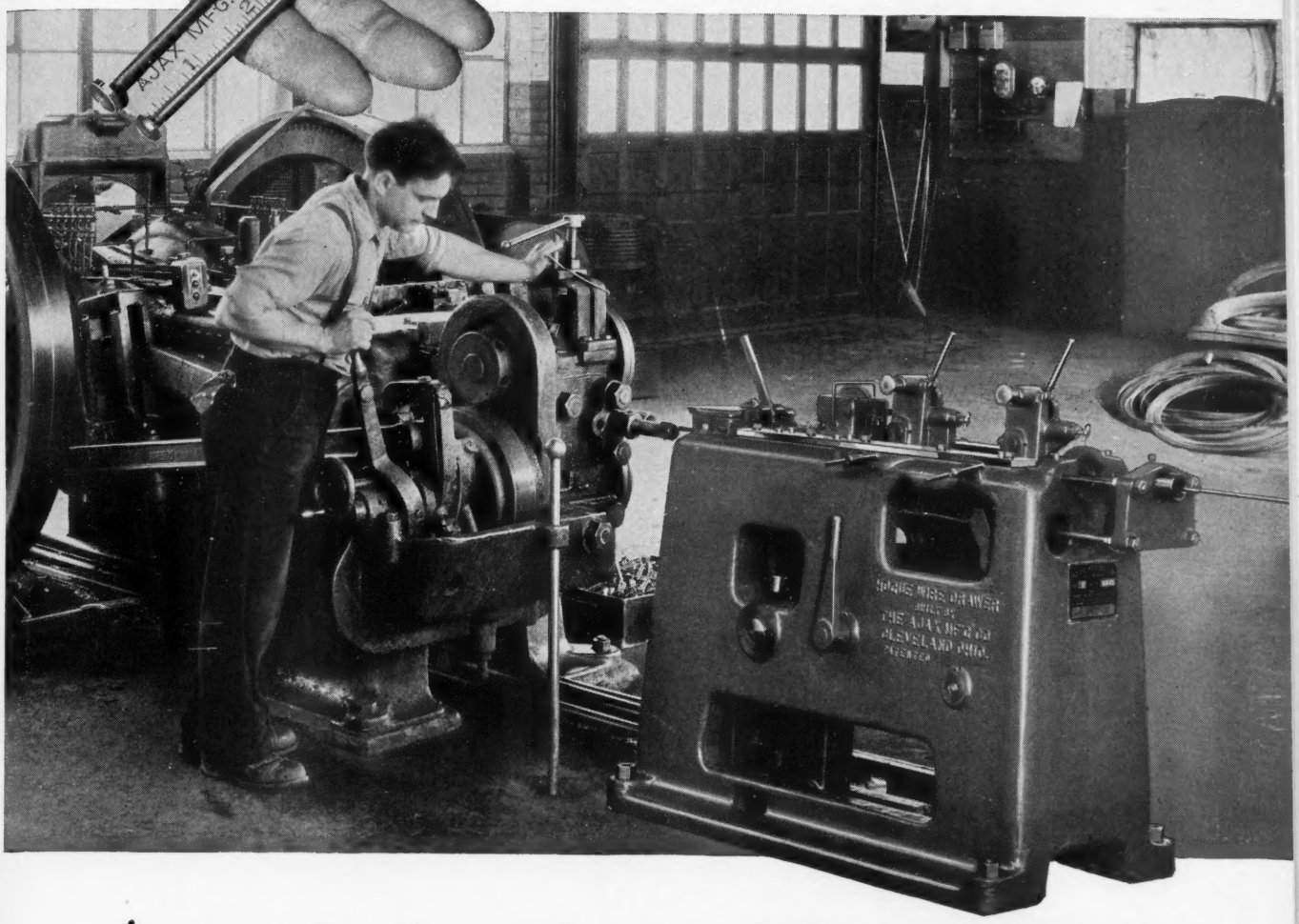
R. H. MILLER COMPANY

HOMER, NEW YORK

Established 35 Years

Tel. No. Homer 192

Use AJAX-HOGUE WIRE DRAWERS *with* your Cold Headers



.... *for* Straight, Close Tolerance, Cold Headed Products

Long bolts and screws, for the aircraft and automotive industry, as well as a wide range of other headed products, can be produced with uniform straightness and with unvarying diameter from wire freshly drawn and coated on an Ajax-Hogue drawer. In addition to the improvement in the quality of the products produced there are many advantages offered by this drawer which substantially lower production costs.

1. Highest quality products can be produced from hot rolled stock instead of the more costly cold drawn wire.

2. The wire is freshly drawn and perfectly coated as it is fed to the header, thus eliminating spoilage due to foreign matter on the wire or prior deterioration of the wire.

3. Heading Die life is greatly increased, due to easier heading made possible by the low yield point of the freshly drawn wire and the uniform size and clean coating of the freshly drawn wire.

Ajax-Hogue Wire Drawers are built in five sizes with capacity from ¼ inch to ¾ inch diameter. Write for Bulletin No. 111 for more complete information.

THE AJAX MANUFACTURING COMPANY
EUCLID BRANCH P. O. CLEVELAND 17, OHIO
312 WESTMINSTER BUILDING · CHICAGO 3, ILLINOIS

MEAKER PROCESS
for
Electro-Galvanizing
WIRE

Offers the most modern, flexible, and uniformly satisfactory method for protecting wire from corrosion.

ALL GRADES, SIZES, QUANTITIES

Whatever the grade, type, or size of wire, the best way to galvanize it is the Meaker way! From small quantities to the largest tonnages, there is an efficient Meaker plant especially planned for the most advantageous operation.

HIGH CARBON OR LOW CARBON STEEL

No softening, weakening, or embrittling temperatures in the Meaker process! From the hardest of high carbon wire to the softest low carbon, any type of steel can be coated with the same superb galvanizing, without impairing the physical properties in any way.

LIGHT OR HEAVY COATING

Fit the coating to the use of the wire! 0.1 oz./sq. ft. may be applied where service is brief or not severe; up to 3 oz. for years of heavy service in bad atmospheres. Coating thickness is controlled precisely and quickly, and since even the lightest coating is perfectly uniform, the wire gets full protection without wasted zinc.

SIMPLICITY

The simple requirements for best operation are quickly grasped by alert foremen; no highly trained labor is needed. Easy predetermined procedures maintain operation at peak efficiency. No complicated analysis or chemical additions are required.

FOR BETTER GALVANIZED WIRE USE MEAKER PROCESS.

THE MEAKER COMPANY

1629-41 South 55th Avenue
CHICAGO 50, ILLINOIS

TUNGSTEN-CARBIDE DIES

Manufacturers of regular and special-shaped dies for many years and specialists in tungsten-carbide dies since their advantages were first discovered—that's the experience behind every Hartley die. Skilled workmen, extreme care and critical inspection . . . your assurance of highest quality and service, symbolized by the heart on every die.

L E Y

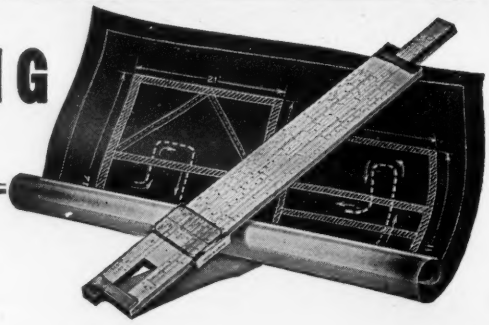
EYELET DIES
TAPER BODY DIES
HEADING DIES
GUIDE RINGS
BUSHINGS
SHOULDER DIES
TUBING DIES
EXTRUSION DIES
SPECIAL
WEAR-RESISTANT DIES

AUTHORIZED SUPPLIERS OF CARBOLOY CEMENTED CARBIDES

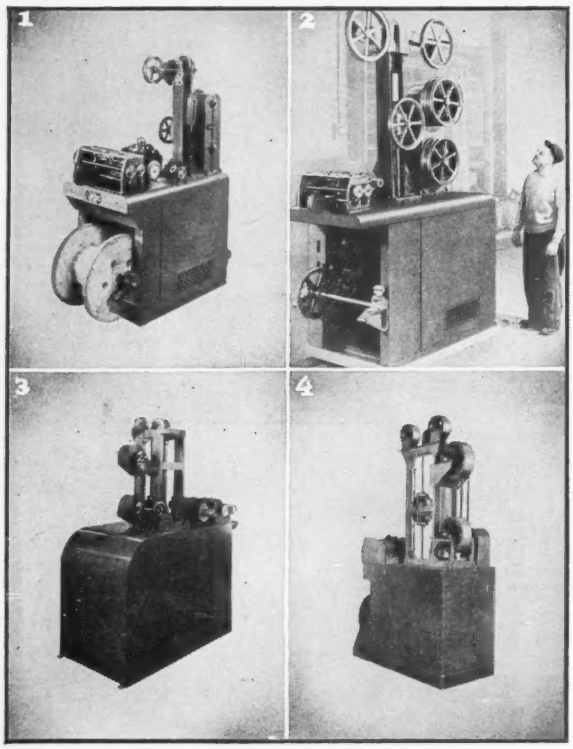
HARTLEY WIRE DIE CO.

Established 1850
Thomaston, Conn.

OVEN ENGINEERING NEWS



IOE Constant-Tension Windups Now Available for Wide Range of Processing Applications



THE coating, impregnating and drying of continuous materials, such as insulated wire, cable, tape, yarn, fabrics and cords, is a task which demands top engineering and machine design skill. One of the most important factors in any coating systems is the windup machine, providing the motive power to draw materials through coatings, saturants and drying tower All IOE windups, such as those shown above, are built on the same basic design, yet that design is flexible enough to suit a variety of applications.

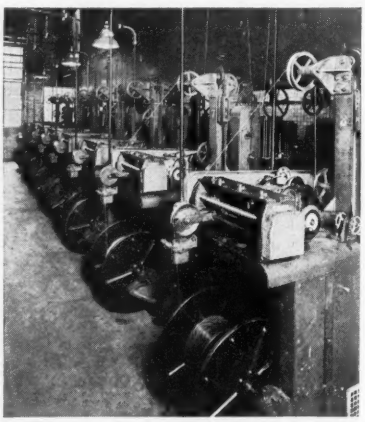
Fig. 1, left, shows a high-speed, low-tension unit for lacquering, saturating, waxing, respooling and mono-filament impregnation. It will handle materials from .010″ to .385″ diameter at speeds up to 1500 feet per minute.

The large machine in Fig. 2 is a heavy-duty extrusion take-up for large diameter cable running at low speeds and high tensions. It handles flexible materials up to 1.50″ diameter at speeds from 25 to 240 feet per minute, with tensions as high as 500 pounds.

The saturating takeup in Fig. 3 is designed for medium speeds and tensions. This machine handles material up to .750″ diameter at tensions up to 100 pounds and speeds from 80 to 480 feet per minute.

Flat materials such as tape and textiles are handled by the machine in Fig. 4. This particular model is designed for materials up to 6″ wide and .060″ thick, though wider rolls are available. Tension is adjustable over a wide range, and the speed change ratio is 10 to 1.

All machines are available with hydraulic, electric or electronic synchronization, and with traversing mechanisms for wide lay range adjustment. Multiple units handling up to 12 ends simultaneously also are supplied by this company, a good example being the eight-end example shown below, in operation at the Lenz Electric Company of Chicago.



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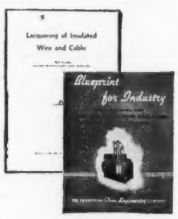
You may obtain, without charge, full data on windup machines and complete coating systems for continuous materials. Just drop us a line.



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"Alcoa Aluminum Armor"

Non-sparking Alcoa Aluminum armored hose can be safely dropped or dragged on steel boat decks or docks. No sparks, no "booms" where highly volatile gasolines and naphthas are being pumped.

Light weight, flexibility, durability, resistance to corrosion, and ability to withstand hydrostatic pressures . . . these are the other requirements of fueling hoses readily met by Alcoa Aluminum armoring.

Do all these properties of Alcoa Aluminum wire and rod, plus being non-magnetic and having high electrical conductivity, suggest an application in your products? Alcoa engineers will gladly give you the benefit of their experience in determining the facts. Write ALUMINUM COMPANY OF AMERICA, 1828 Gulf Building, Pittsburgh 19, Pennsylvania.

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WIRE SPARKING ELECTRODE UNITS

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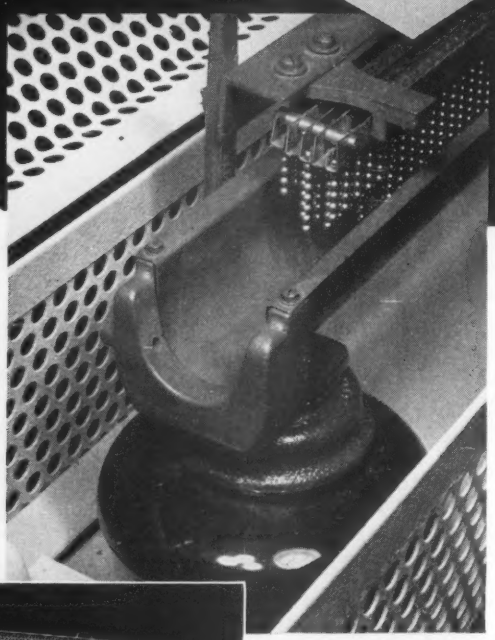

Cut-1 Electrode unit showing petticoat insulator.

Electrode unit showing guard open.

Electrode unit showing guard closed.

No JLE Replacement Units have to be purchased to make JLE Electrode Units meet Underwriters' standards.

FOR the past ten years all JLE Spark-testing Electrode Units have been built to such high standards that today, without any additions or replacements, they meet Underwriters' requirements.

Exclusive **JLE** *Electrode Unit Features Include:*

PETTICOAT INSULATORS that protect against moisture (see cut 1)

CHAINS lift longitudinally, allowing easy feeding of wire, also permits examination of chains and trough for breakage, wear of chains and accumulations of wax. The chain units are easily replaced when worn and the method of suspension does not permit crowding to one end.

SAFETY SWITCH deenergizes Wire Sparker and stops Automatic Reeler or Coiler if guard is raised. Cover interlocks so that chains must be down and guard down before Sparker can be energized or Reeler started.

RENEWABLE PORCELAIN GUIDES protect wire from damage as it enters and leaves electrode unit.

LONGITUDINAL closing action of the chains covers the entire wire.

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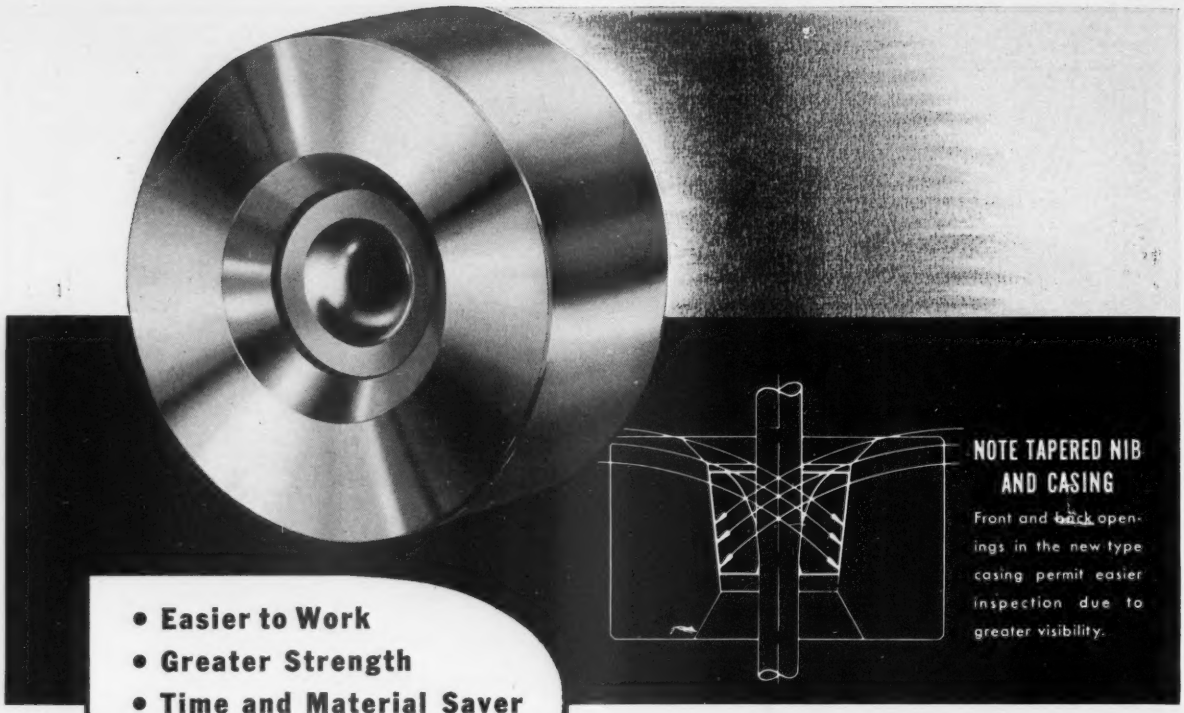

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- Time and Material Saver
- Better Lubrication
- Full Visibility

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Front and back openings in the new type casing permit easier inspection due to greater visibility.

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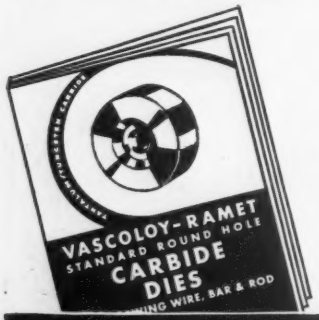
Tantalum/Tungsten

Carbide Dies . . .

. . . for Drawing Wire, Bar and Rod

A BOOK ON STANDARD ROUND HOLE DIES just off the press will be helpful to you. Write us for Bulletin VR348.



Maintain size longer and produce better finish. Tantalum/Tungsten Carbide has a lubricating characteristic which greatly reduces mechanical resistance in drawing, and in so doing, enables a much smoother finish. Many mills report longer productive life, less down time, greater tonnage per die and greater operator satisfaction.

4533

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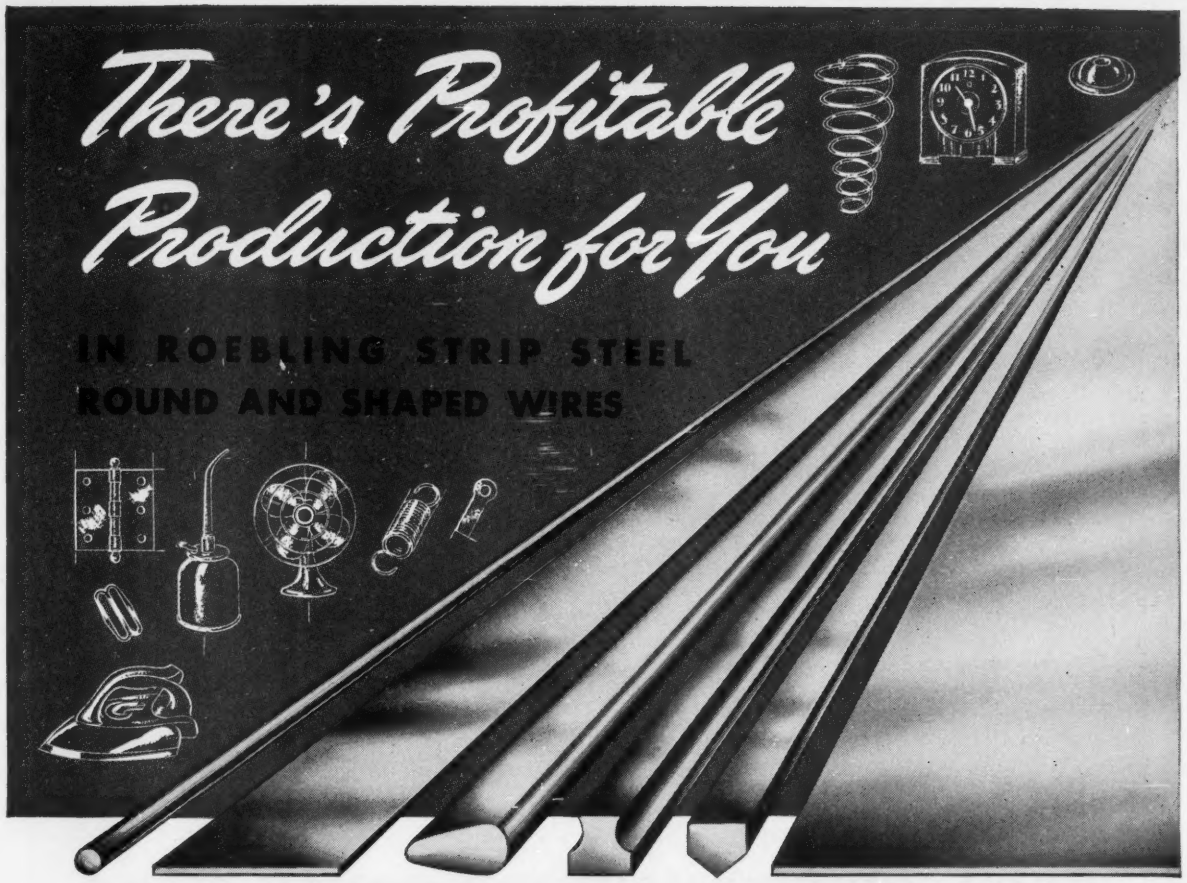

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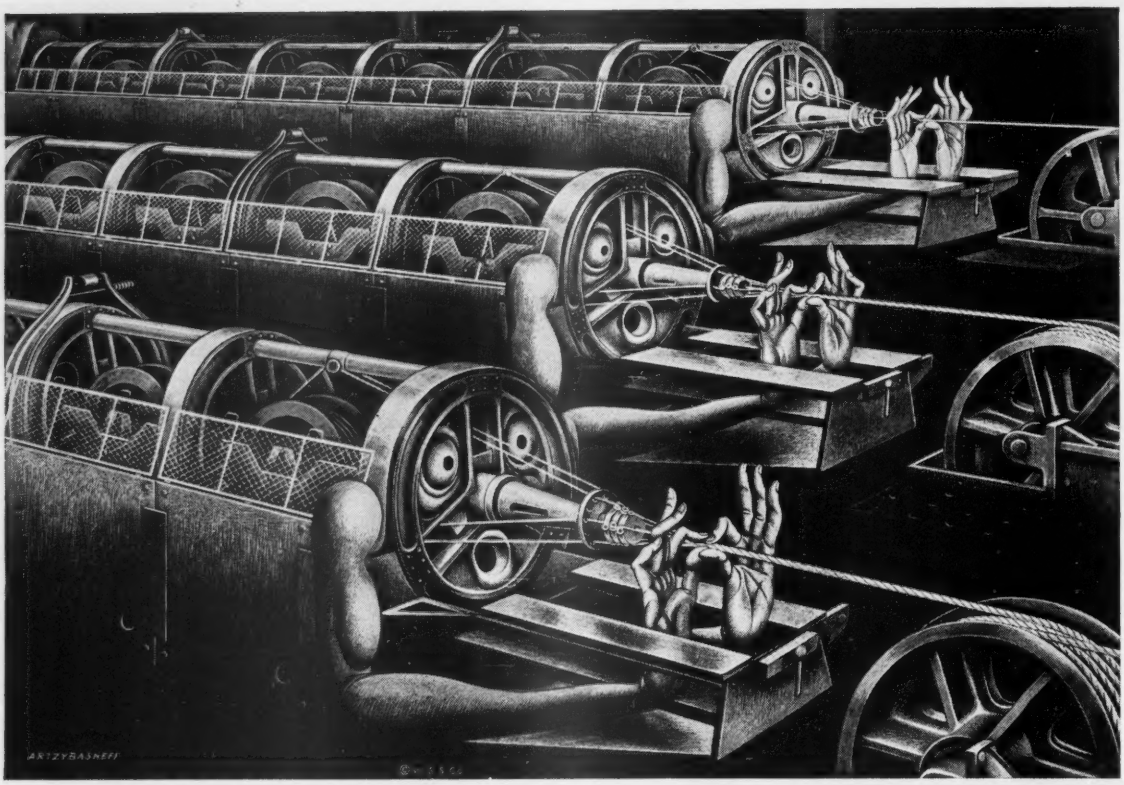

Ninth of a series of Artzybasheff's impressions of the manufacture of steel wire products

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Spinning six strand, steel-sinewed wire rope at high speed . . . the job of a closing machine . . . calls for tough, skillfully prepared rope wire.

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If you want steel wire of any size, temper, analysis or finish; round, flat or shaped; send your order or inquiry to Wickwire Spencer. We'd like to add your name to our long list of satisfied customers.

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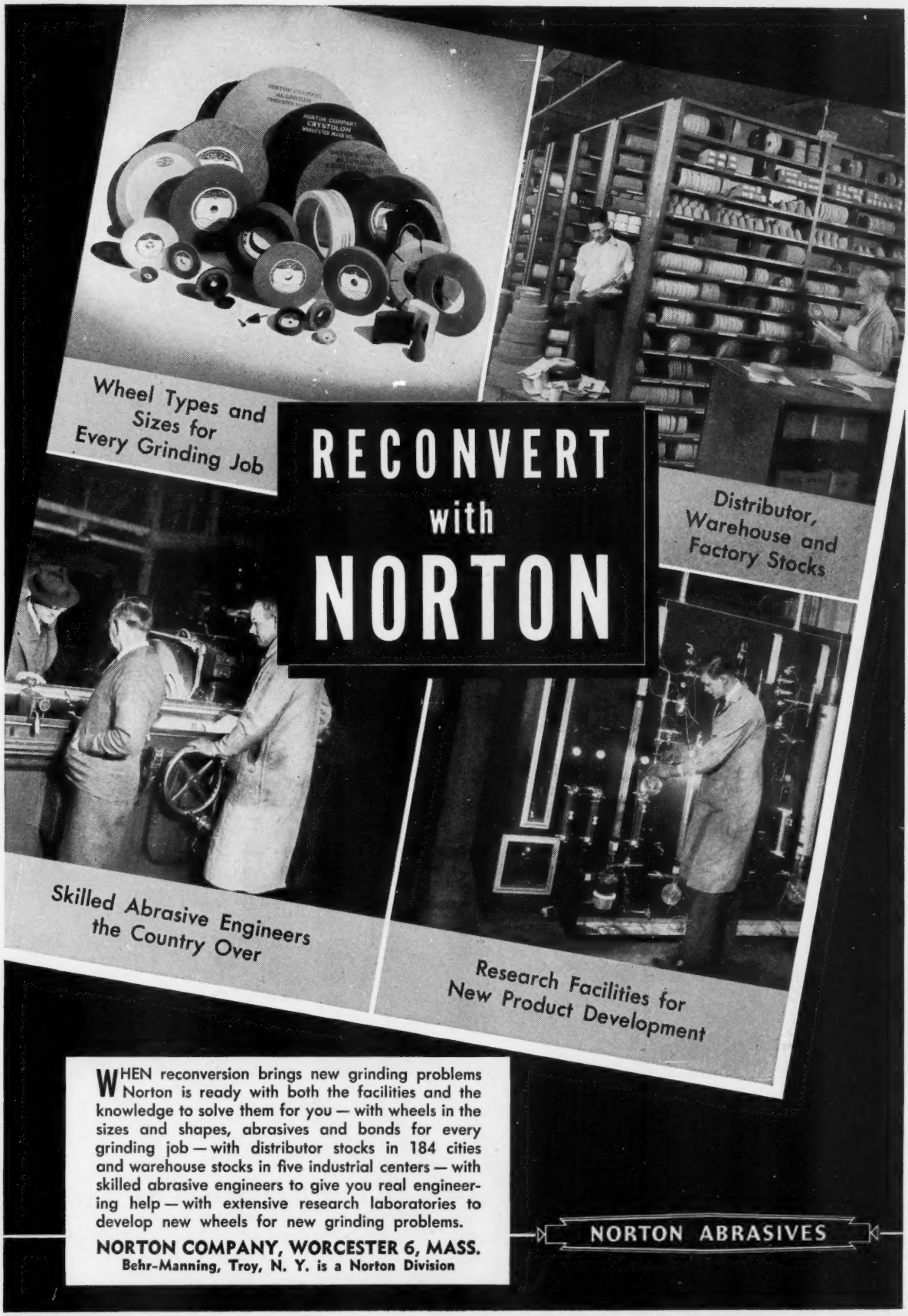
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ANSWER: "Only the wire that's made for the job!"

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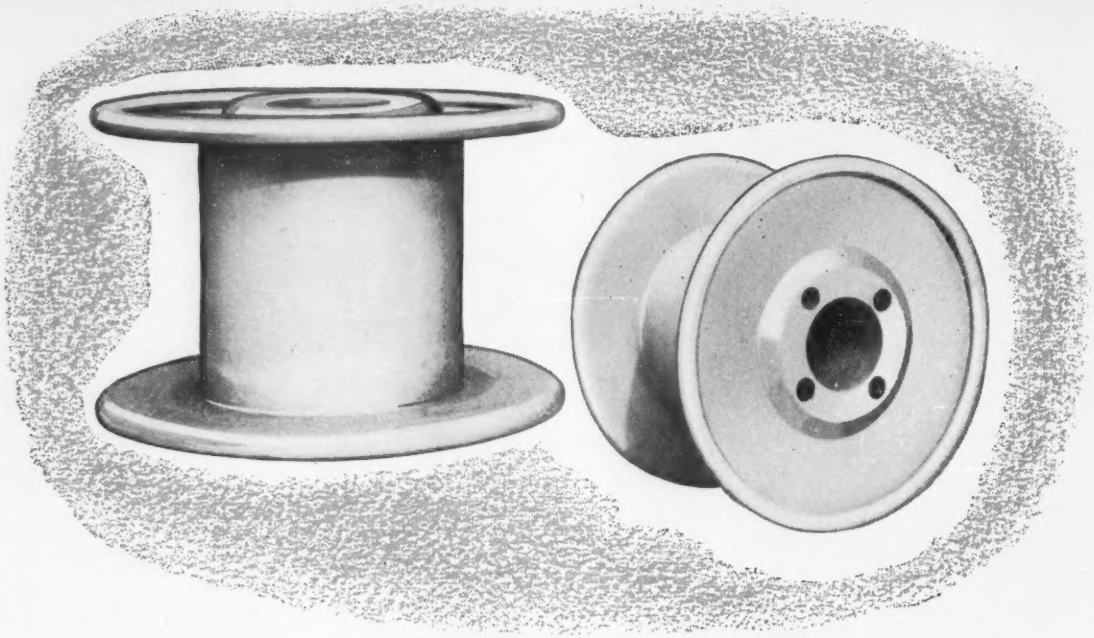

This Stronger Steel Reel Takes Higher Winding Speeds

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Strong construction prolongs usage and lowers replacement cost.

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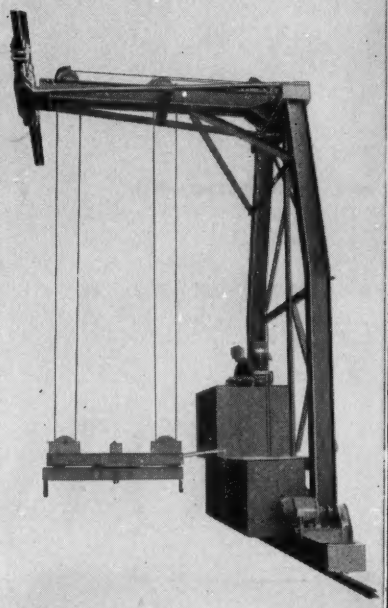
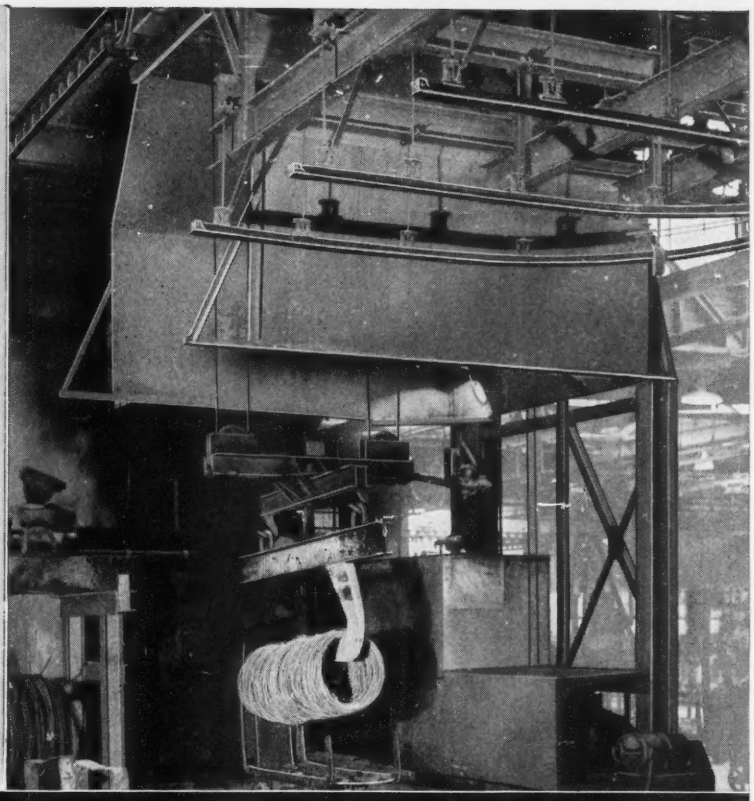
Canadian Representative HUGH WILLIAMS & CO., 79 Wellington St. West, Toronto, 1, Canada

One of the two gantry cranes serving parallel lines in the cleaning house of The Steel Company of Canada, Hamilton, Ontario. The crane below is the same as at right, before it was shipped from the Cleveland Tramrail factory. All electrical and hoisting machinery are away and protected from the acid and fumes.





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... in the CLEANING HOUSE

Cleveland Tramrail cleaning house gantry cranes have revolutionized operations in the cleaning houses of many wire and wire products plants. They enable one man to perform all operations in the cleaning house — acid bath, rinse, lime dip, bake — and of significance more tons can be cleaned per day than by customary methods. Consequently the cost per ton of rod cleaned is far less by the Cleveland Tramrail way.

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The degree of success which wire producers and fabricators attain in the days ahead will depend upon their methods and equipment. Now is the time to begin giving serious thought to your cleaning house as well as to the other departments of your plant. Our engineers will be glad to give you the benefit of their many years of practical experience.

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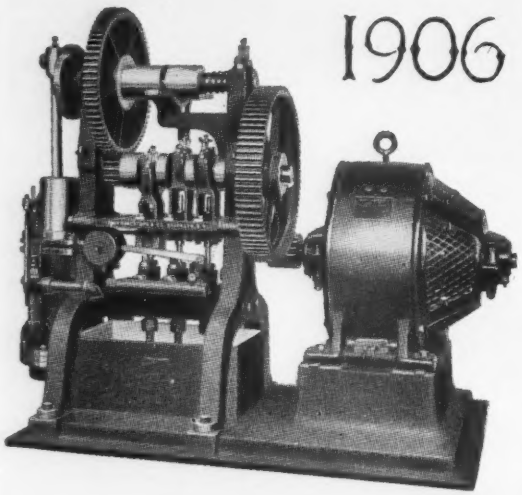
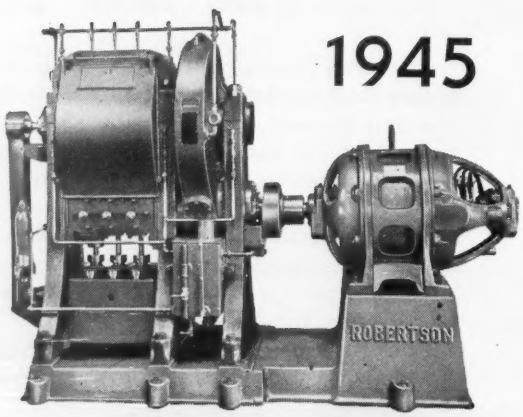


1906

THEN, as NOW .... a Leader

To the modern eye, trained to the sleekness of streamlining and safety-design, the Robertson electrically-driven hydraulic pump above, seems a museum piece. But we at Robertson are as proud of it as we are of its modernized descendant, below. For in 1906, this hydraulic pump was outstanding in its field — embodying all the newest principles and the latest in engineering advancement known at that time. Too, we are justly proud of the 1945 model, for it illustrates clearly how Robertson research and awareness of all recent developments bring you "custom-built" equipment, endowed with the excellence of superior craftsmanship — new to the Nnth degree.



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The superiority of Apex Draw-Alloy is evidenced in prolonged die life, increased pounds of wire per hour, and consistent high quality of finish.

We would be pleased to discuss the use of Draw-Alloy with you.

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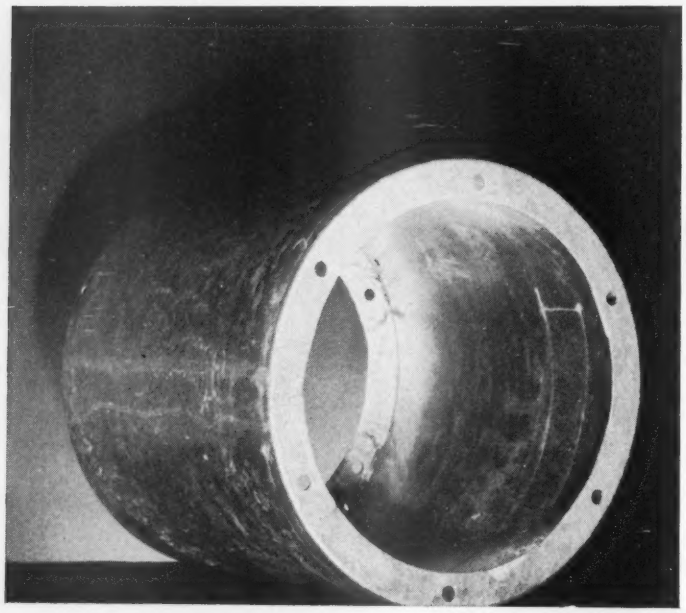

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Hard, firm, dry coated rods, of all types and sizes, from 200 to 1200 per minute, are uniformly processed, free from marking, in ROSS single pass and multi-pass continuous type ovens.

The most exacting care in the production of high quality wire and rods could be wasted as a result of faulty baking of the lime coating. Uniform baking can only be secured by proper circulation and control of sufficient clean air heated to the correct temperature and maintained at that temperature.

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SEND FOR THIS BULLETIN — IT'S FOR YOU

THE LABORATORY GROUP — fresh from the press — will tell you why the Royle No. 1/2 and the Royle No. 1 are the extruding machines you will want to know more about when you plan for post-war production and put those plans into operation. In an entirely evolutionary manner features have been built into these machines which will secure successful results with the ever lengthening list of extrudable compounds.

Whether your plans involve research or light product extruding THE LABORATORY GROUP bulletin gives you the basic data you will require . . . If you plan a program of research you will find that these extruding machines have the characteristics for heavier product extruding . . . If you plan a program of light product extruding you will find it more profitable to use an extruding machine specifically designed for such work.

Send for your copy of THE LABORATORY GROUP and let it suggest to you how these extruding machines — Royle No. 1/2 and Royle No. 1 — can meet your specific requirements.

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LICENSED UNDER U. S. PATENTS

for WIRE COATING

NOW AVAILABLE in Sufficient Quantities to Meet Increased Demands

Stancoat has been compounded to replace lime and other similar coating materials used in drawing of rod or wire.

STANCOAT POINTS OF ADVANTAGE

1. Use one pound or less per ton.
2. Die life increased over use of lime coating.
3. Percentage of rejections due to scratching, out-of-round, or off-size reduced to fraction of 1%.
4. Lubricant cost reduced by one-third or more.
5. No dust created so air and machines remain clean, and great improvement in working conditions is obtained.

Although STANCOAT costs considerably more than lime, it has been found that the total saving has been offset by the difference between the unit cost of the coatings involved.

Write us for complete instructions of application and testing. STANCOAT is shipped in wooden barrels with an average weight of approximately 300 pounds.

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STANDARD INDUSTRIAL COMPOUNDS COMPANY

4600 W. Ferdinand Street, Chicago 44, Ill.

Standardize with Standard

NEW CAPSTAN and TAKE-UP

for

PLASTIC EXTRUDING MACHINES USED FOR INSULATING SMALL WIRES

This apparatus consists of a motor driven capstan and a separate motor driven take-up.

The capstan has a variable speed drive which will give a wire speed from 100 to 1200 feet per minute.

The take-up consists of a ball bearing motor with a gearhead which is belt connected to the main take-up shaft which is mounted on ball bearing pillow blocks. There is an electrically driven adjustable traverse which will take care of various size reels. The tension and speed of the take-up is entirely controlled by the slip of the motor, which automatically varies with the speed of the capstan resulting in a slight but constant tension on the wire at all times.

This combination of separately motor driven capstan and motor driven take-up, eliminates the need of slip clutches or tension regulating devices. The motor itself produces only enough torque to hold the wire tight so that the reel spools up properly. With a slipping clutch or a mechanical variable speed or variable tension, there is always danger of too much tension, resulting in stretching the wire on the take-up.

When the take-up starts, the reel, of course, is empty and quite light and this helps the take-up to come up to speed and as the wire builds up on the reel, naturally the r.p.m. on the take-up reduces, so in effect you have a small flywheel and the only energy required to drive it is the friction load. The wire itself is being driven ahead by the capstan so that the tension on the wire is practically nil. This is particularly true in stranded and flexible conductors where there is no power required to bend the wire in the reeling operation.

For full details address inquiries to

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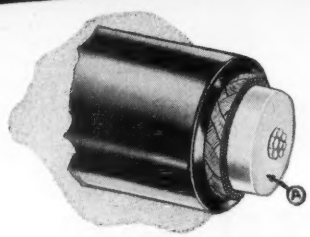
DU PONT PLASTICS
are available for peacetime use

HERE IS WELCOME NEWS for the electrical manufacturer. These Du Pont plastics, after years of use in war products, are now available for civilian applications. Speeded by the urgencies of war, research has found new and varied uses for each. Here they are, ready to help you make your product more useful, more attractive, more salable.

Du Pont POLYTHENE

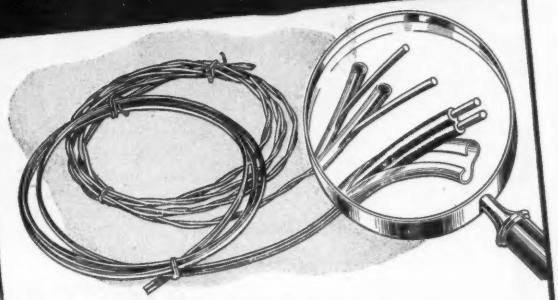


Cross-section (4 2/3 times actual size) of coaxial cable used in television transmission by Allen B. DuMont Laboratories, Passaic, N. J. Polythene's non-polarity is an additional advantage here, since the current sometimes changes direction at 100 million cycles per second. (A) Polythene insulation.

This chemically inert plastic, first developed during the war, offers a unique combination of valuable properties. Polythene's specific gravity is 0.92. It is admirably suited for insulation of high frequency wire, where its low electrical losses and general physical and chemical characteristics are unequalled by any other material. Polythene is flexible yet tough, at temperatures ranging from −50° F. to 220° F. It can be injection- or compression-molded or extruded.

Uses: Polythene has been used to insulate the well-known assault wire used by the Signal Corps.

Du Pont NYLON



Telephone drop wires, of parallel and twisted type, manufactured by a prominent Eastern maker of wire and cable, using an extruded jacketing of FM-105 nylon. Because of the toughness of nylon, only a very thin coating need be applied, which produces a wire of relatively small total diameter.

Nylon molding powders, developed during the war years, offer unusual toughness and flexibility, at service temperatures far higher than those possible with other thermoplastics. Five different formulations are now available, giving a selection of specific attributes for different jobs.

Uses: Among the successful uses of nylon molding powder FM-105 (a nylon stabilized against deterioration by prolonged exposure to heat), are tough, flexible jackets for telephone drop wires. Applied by extrusion, these jackets resist abrasion, eliminate fraying, protect the insulation, insure long life.

Du Pont engineers will gladly assist you in deciding whether these or other Du Pont plastics can meet your product needs. Address E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

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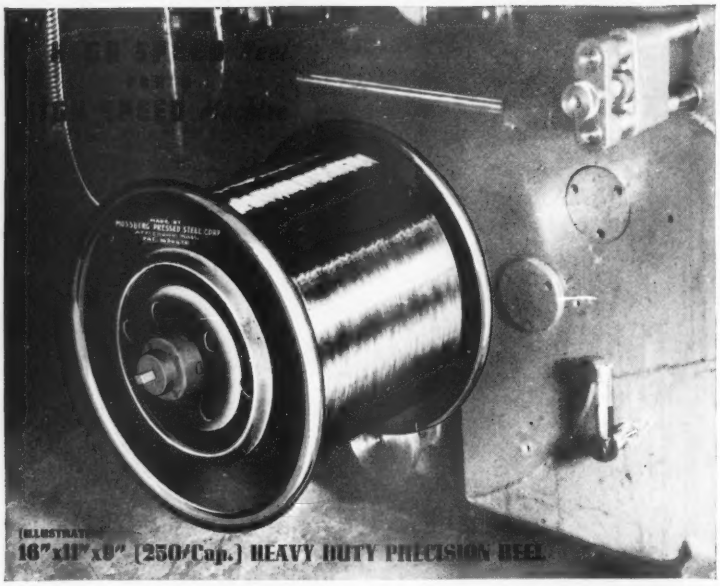
GREETINGS



1945

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in HEAVY DUTY construction for use on modern HIGH SPEED wire drawing machines.

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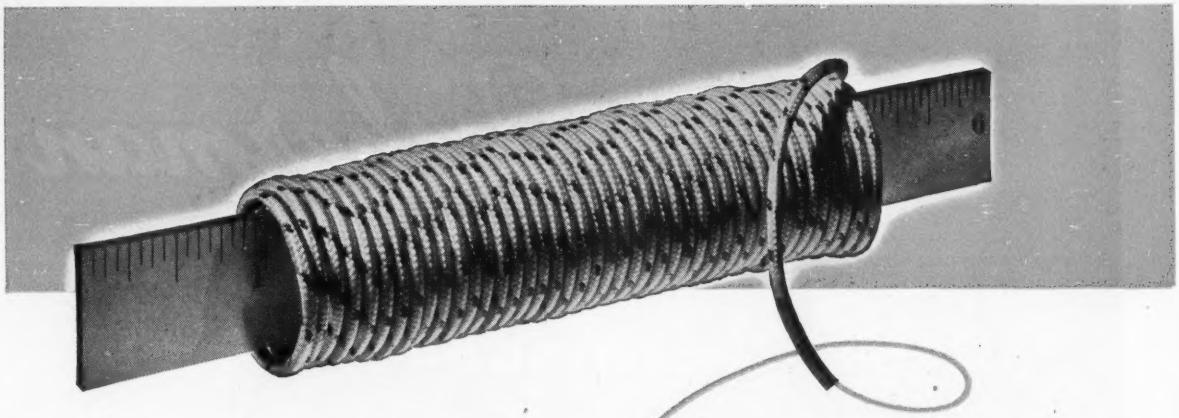
to the

Annual Convention of the Wire Association



MORE SPACE FOR *Copper* WITH LEXEL INSULATED WIRE

For a wide variety of low-tension uses, where space is scarce, the small bulk and low weight of Lexel insulated wire offer proven advantages. These are evident in such applications as instruments, controls, lead-in and hook-up wire and electronic circuits.

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The value of Lexel (cellulose acetate butyrate) has been proved in many critical military installations. High dielectric strength and insulation resistance and low moisture absorption permit major improvements in numerous new peacetime products.

Send for test samples and the names of manufacturers supplying Lexel insulated wire and cable—and see for yourself its practical value for your own products.

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As a regular service, Dobeckmun engineers also develop laminated insulation products, custom-made to special purpose specifications, such as slot cell and phase insulation for motors, insulation for shipboard cables and other uses. If your requirements are unusual, call on us.

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The photograph shows finished rods, still red hot, being reeled into 340-lb. bundles, coiled two at a time. After cooling, pickling and other preparatory processing, the rods are drawn through special dies. At every stage, operations are under close control.

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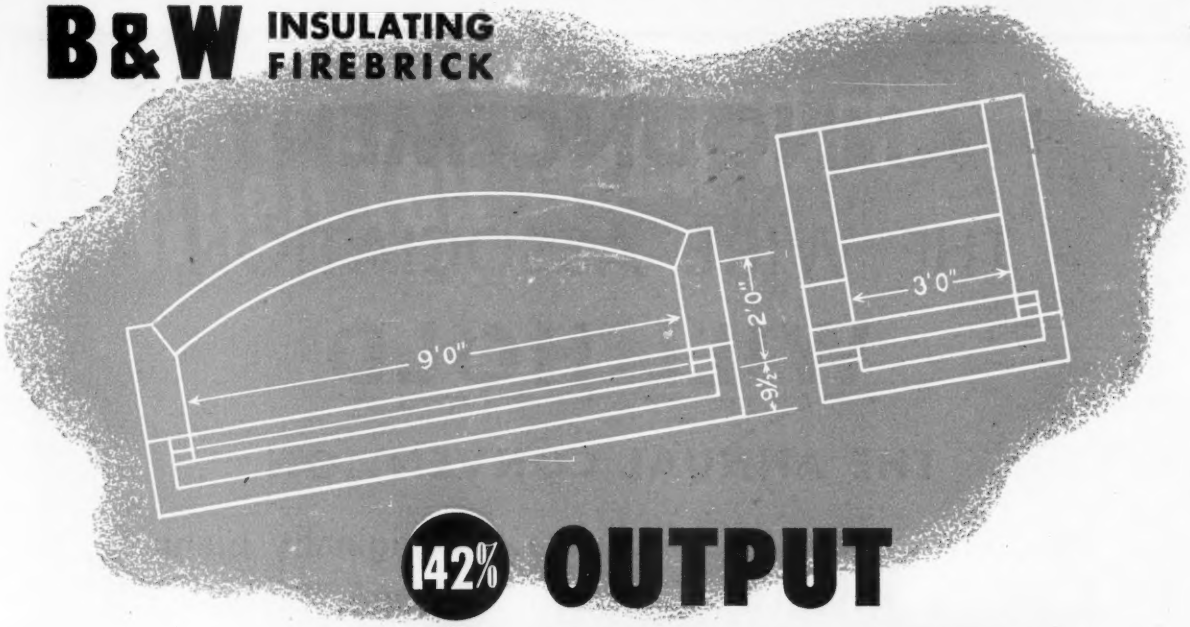
B&W INSULATING FIREBRICK



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50% FUEL

An Illinois gas-fired forge furnace produced 70 pieces per hour in furnaces lined with first-quality fireclay brick. When B&W K-28 Insulating Firebrick were substituted, output jumped to 100 pieces per hour—over 42% increase.

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Furthermore, fuel consumption per pound of stock during heat-up period dropped 83%. The overall fuel consumption was cut to less than half that required with dense firebrick.

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FURNACE DATA

TYPE
—forging furnace

FUEL
—800 BTU natural and manufactured gas

TEMPERATURE
—2400 F.

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Refractories Division
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R-212

! ANNOUNCEMENT !

THE WIRE ASSOCIATION

WILL HOLD

THE ANNUAL CONVENTION

October 15-18, 1945 inclusive, as originally planned at the La Salle Hotel, Chicago, Ill.

Up to the end of the war we had made all plans for the Convention, but the directors deemed it advisable to withhold making application as a patriotic duty.

Now, however, with the relaxation of restrictions on travel and the holding of conventions, we are happy to announce the

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There will be much to discuss as a result of the new problems. So please make your plans now to attend and notify us as quickly as possible as to the hotel accommodations required. Reservation cards are being sent to all members. The La Salle will not accept any reservations except through this office.

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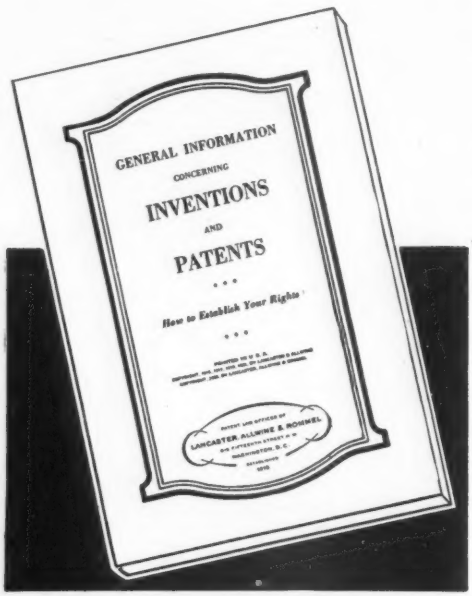

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Fiberglas insulated magnet wire is made in several types: SC, DC, SGE, DGE, SGF, DGF, SGHF, DGHF, etc.
Fiberglas braid covered lead wire is available in many sizes
Aircraft and automotive ignition cable, with Fiberglas advantages, is available in several sizes
Fiberglas insulated, low tension, hook up wire for many radio and electronic applications
Many different types of Fiberglas-insulated wires are being produced by the leading wire manufacturers, for a wide range of applications.
For example, Fiberglas insulated magnet wire is being used as a basic component of modern generators, electromagnets, transformers, heating and ignition devices, radio parts and communication equipment. It is available in sizes from heavy #0000 to the fine #42 wire used in electronic coils. Single, double and triple layers of multiple wound Fiberglas Yarns are applied over round, rectangular, solid or stranded conductors, over bare copper or over various types of enamel or felted insulations.
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Most Fiberglas-insulated magnet wire is varnish impregnated. The strong, flexible Fiberglas covering is thus effectively protected. Moisture resistance, much higher than that of other types of wire insulating materials is also increased. Varnished Fiberglas insulated wire assures a better safety factor for apparatus designed to operate at either high or low temperature.
The dielectric strength of impregnated Fiberglas insulated wires compares favorably with that of other types of magnet wire. Moreover, this dielectric strength is retained at temperatures well beyond the destruction point of the organic materials frequently used in magnet wire insulation.
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In addition to Fiberglas-insulated magnet wire there are many other constructions which incorporate the advantages of Fiberglas Yarns. Fiberglas insulated lead wire is widely used on equipment in which the major insulation is also Fiberglas. Radio hook-up wire, a modification of the lead wire construction, is used in electronic devices where the minimum build-up, fungic resistance, flame resistance and durability afforded are of primary importance.
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The high heat resistance and ability to meet small space limitations has also lead to its use for thermocouple wire, appliance lead wires, stove wire, waffle iron hinge wire, heater cords, Litz wire, etc.
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Each distributor of Fiberglas-base Insulation Materials has his own source of supply, since Owens-Corning Fiberglas Corp. does not process these materials.
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ELECTRICAL INSULATION MATERIALS
Trade Paper Ad No. 5-7114
for Electrical World, July 21 and Electrical Engineering, July, 1945
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It works
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The advertisement shown above is appearing in leading electrical trade publications. It is telling thousands of readers about Fiberglas*-insulated wire.

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Why not cash in on the expanding market for Fiberglas-insulated wire and cable? Reprints of Fiberglas advertising and copies of the new catalog are available for use by wire and cable companies. Write *Owens-Corning Fiberglas Corporation, 1875 Nicholas Building, Toledo 1, Ohio.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

FIBERGLAS *ELECTRICAL INSULATION MATERIALS*

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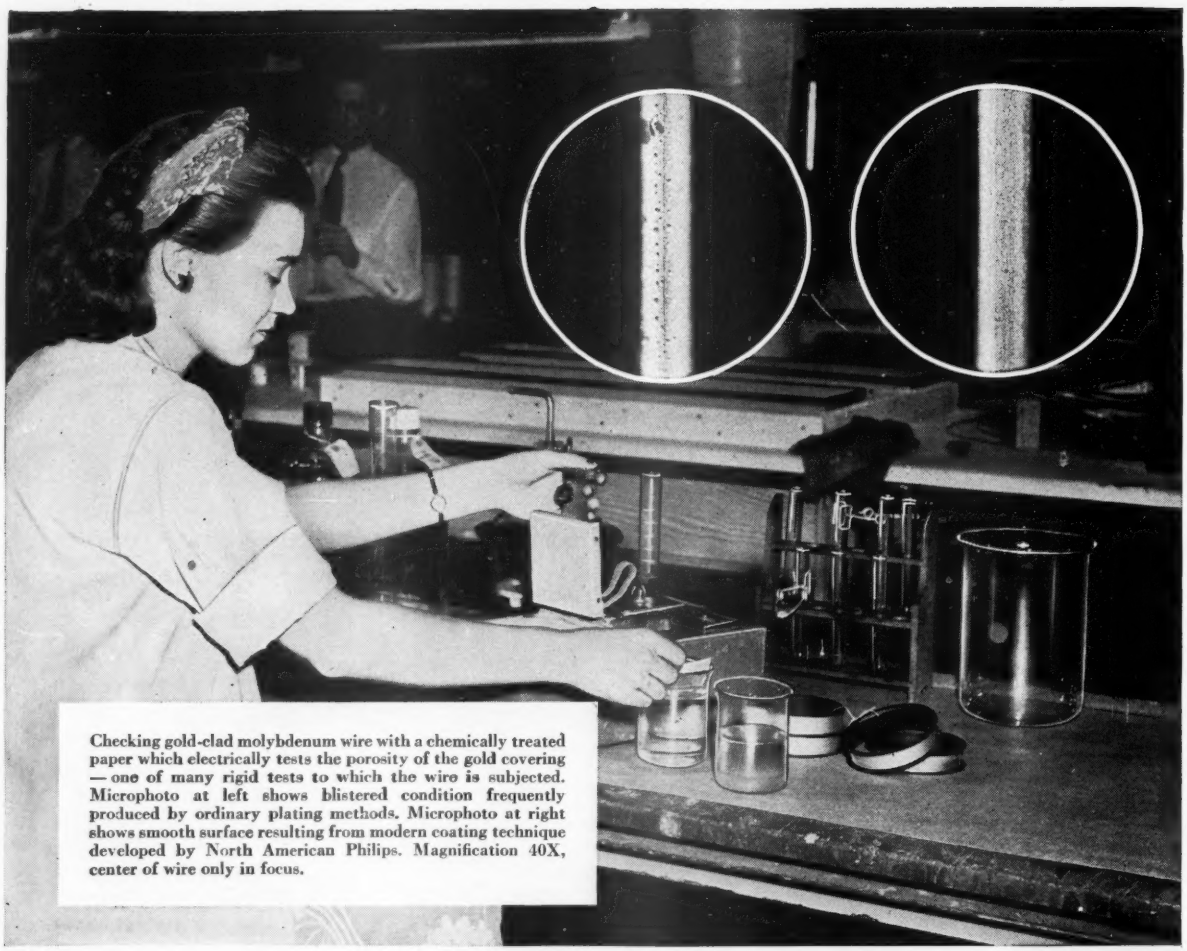

Checking gold-clad molybdenum wire with a chemically treated paper which electrically tests the porosity of the gold covering — one of many rigid tests to which the wire is subjected. Microphoto at left shows blistered condition frequently produced by ordinary plating methods. Microphoto at right shows smooth surface resulting from modern coating technique developed by North American Philips. Magnification 40X, center of wire only in focus.

Pioneer U.S. *Producers of* GOLD-CLAD *Fine Wire*

North American Philips has pioneered two important developments in gold-clad fine wire. The first was the domestic production of gold-coated fine wire for military uniforms. Developed early in 1942, we were in production by October of that year.

Then, new electronic tube developments created a war-born demand for gold-coated molybdenum fine wire, which North American Philips also developed.

Today we are exclusive suppliers of gold-clad fine wire to many leading electronic tube manufacturers and makers of military insignia. On fine tungsten, molybdenum and silver wire, we can produce a smooth, even, non-blistered, non-porous gold coating with these features: It *sticks*, even when elongated. It *guards against undesirable grid emission* in electronic tubes. It can be *controlled to rigid customer specifications.*

These superior qualities are the result of highly specialized equipment and closely controlled processing techniques developed by an organization with a background of over 50 years' experience in the electrical field. North American Philips manufactures fine wire below .003″ diameter in silver, nickel, copper, nickel chrome and aluminum alloy; also silver, tungsten, molybdenum and alloy wire up to .010″ clad with gold, copper or other materials.

Many manufacturers have found our unusual skill of great value in helping them meet exacting production schedules. When you have a fine-wire problem, call on our specialized engineering service.

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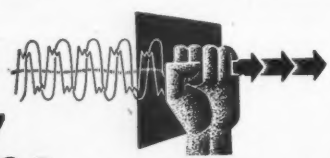
Precision wire-wound resistors; hearing aids; radio headphones; sensitive recording and indicating meters; sensitive relays; electronic tube grids and filaments; sound recording on steel wire; fractional horsepower motors; wire braid and cloth; and hundreds of other uses wherever very fine wire is required.



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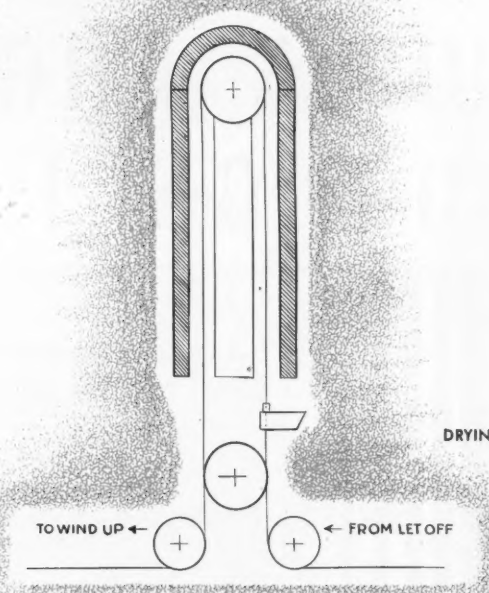

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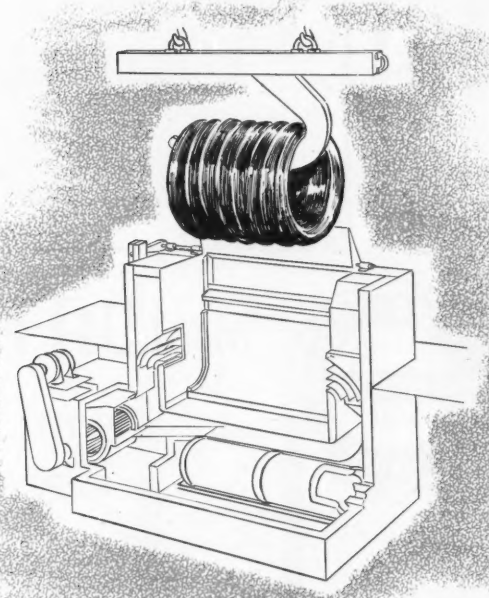

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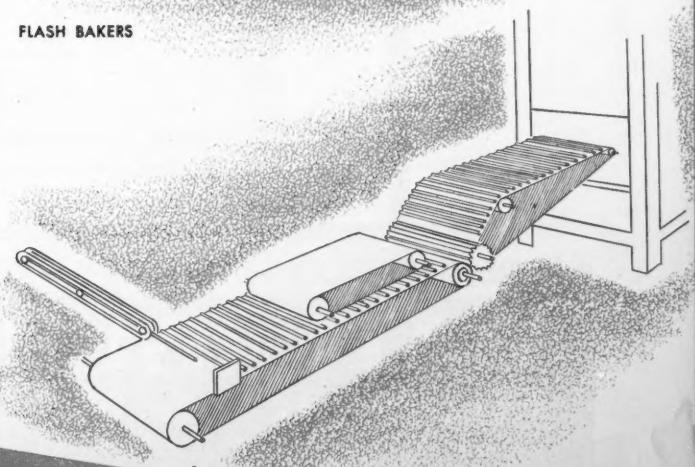

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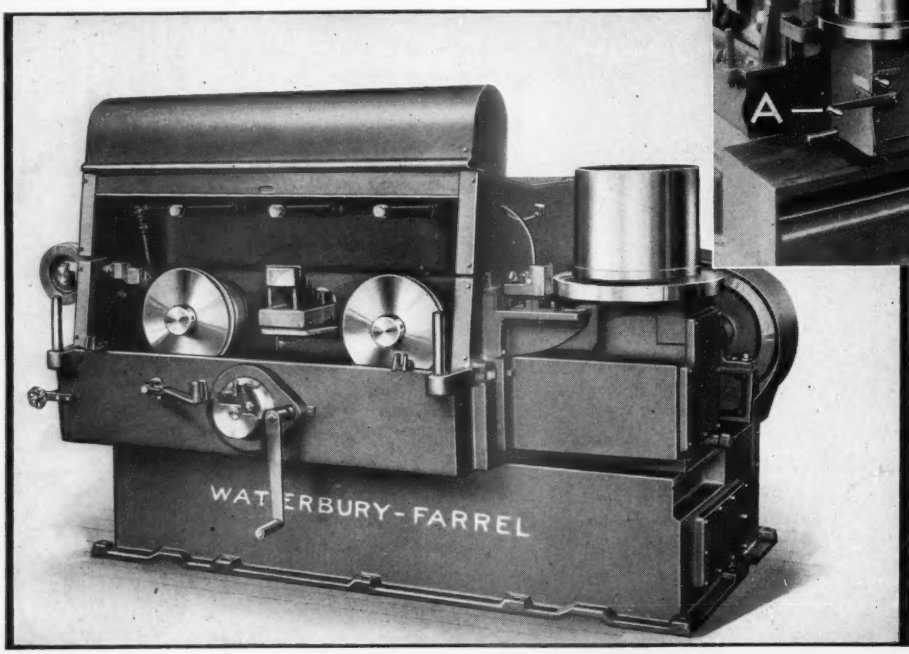
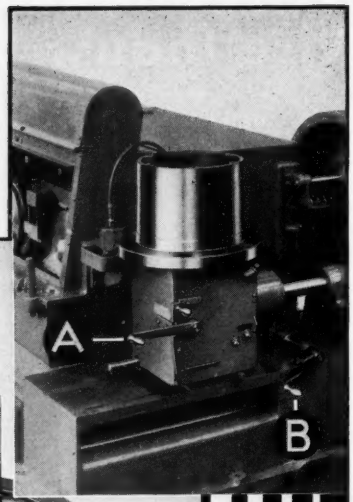
OVENS

WIRE DRAWING MACHINES





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Upright Cone Continuous Machines with provision for quickly changing the rotation and position of block.

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 20 OCTOBER, 1945 No. 10

Designated as

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 20 OCTOBER, 1945 No. 10

Some Traits and Characteristics in the Working of Beryllium-Copper Wire

By Matthew J. Donachie,

Technical Director, Beryllium Corporation of Penna.,

Reading, Pennsylvania

A paper for presentation at the Wire Association Convention, Chicago, October, 1945. ✦ ✦

BERYLLIUM-COPPER, the heat hardenable copper alloy, has taken its place among the many useful metals used in the wire industry, and its growth of very recent years has been markedly rapid.

✦ ✦ ✦

THIS growth has been due largely to research and developments in the production of suitable wire bars which has practically eliminated the many ingot inheritance faults that made wire manufacture a rather trying and sometimes vexing process. Despite the technological advances in casting and melting technique, certain characteristics of the alloy must be controlled in all redraw operations if wire has to be produced economically on a quality basis. The behavior of the alloy in drawing and annealing and the cleaning coupled with a practical understanding of its special characteristics are essential and it is to these and attending faults generated in practice we shall devote our attention.

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Cleaning

SKIN conditions in beryllium-copper have been recognized as a source of extreme die wear and also a cause of continual breakage due to shedding in drawing operations. This shedding usually fills the tub with a fine red powder which eventually plugs the die. To alleviate this condition, various plating practices with other metals to prevent abrasion of the dies by the oxide and to act as lubricating agents have been resorted to at one time or another. The skin condition is due to surface oxidation and intergranular corrosion brought about in annealing the metal and improper cleaning of the surface prior to drawing. This layer formation, is shown in an excessive condition in Figure 1. Figure 1 is an exemplification of the cause but layers of even minute thickness, enough to produce only surface discoloration, will cause continual trouble and particularly in wet drawing. These layers of corroded metal are readily removed by suitable pickling practice and when the metal is properly cleaned, the resultant wire can be drawn either wet or dry without difficulty. The removal of this oxide film is accomplished by soaking the bundle in a hot sulphuric acid dichromate solution of the following composition:

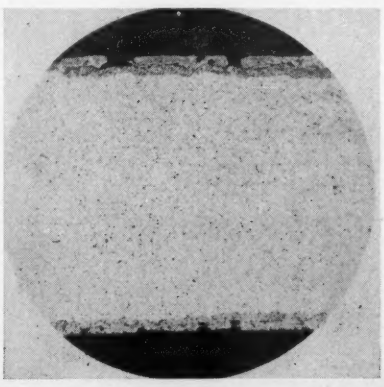

Fig. 1. Layer of intergranular corrosion products, Lntd Sec. 100 X. Light Etch. ammonium hydroxide + Hydrogen Peroxide.

Sulphuric acid, 1 part by volume; water, 4 parts; to each gallon of solution add 4 ounces of sodium dichromate. The temperature of operation is preferred between 140° F and 160° F. The bundle should be held in the bath until a uniform soft brown sludge is formed, removed, water rinsed and struck in a bright dip of nitric acid (1.42 sp. gr.) and water in equal parts.

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THE cleaning practice outlined is a satisfactory means of preparing wire for redrawing but does not lend itself to all ranges of sizes. Preferably the prevention of such conditions in fine wire is desired and this can be accomplished in annealing.

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Annealing

ANNEALING of beryllium-copper to prevent intergranular corrosion is carried out in bulk annealing by use of a protective atmosphere. The atmospheres developed from cracked city gas at a ratio of 2.0 air to 1 gas to 3.0 air to 1 gas when dried to −20° F. will prevent formations of intergranular nature in annealing. However, skin oxidation is still present and cleaning must be resorted to. Strand annealing in hydrogen is undoubtedly the most desirable method for fine wire and its use completely eliminates even minor oxide formations, or intergranular penetration. Cracked gas of the above composition is, however, more economical and with proper drying precautions, a very satisfactory atmosphere.

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SOFTENING at annealing temperatures of from 1450° F. to 1475° F. followed by a quench are required to restore the alloy to a suitable working condition. This quench is necessary to retain the solid alpha solution as formed at the annealing temperature, and complete retention is essential to obtain full response in subsequent working or hardening. Figure 2 is representative of such a structure.

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DEPARTURES from this practice have ofttimes been encountered and it was not an uncommon experience to the wire drawer to find annealed metal that could only be reduced with difficulty and sometimes not at all. Aside from the mechanical obstacle in drawing, the end product varied greatly in properties after the heat hardening treatment. The cause of such wide variation of properties, it has been found, is in most cases attributable to departures from practice as noted above. These faults are in general due to under annealing, usually caused by not allowing the metal to attain temperatures necessary for complete solution treatment or insufficient time at temperature. The latter is very rare, but does happen. Wire which has been overheated with the result that incipient fusion takes place is the common cause of extreme difficulty in further redrawing. Overheating creates the very hard and brittle beta phase as a continuous membrane (Figure 3) which is without a modicum of ductility insofar as wire drawing is concerned. When badly overheated the metal will break up in the quench from the furnace but with only incipient formations, will come through continuously. The material in Figure 3 is from a wire which was so burned, and yet rolled into ribbon which only broke up after the 4 pass in the rolls. Such wire as a rule cannot be drafted even in shallowest passes.

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STRUCTURAL deficiency due to poor quenching unhappily is not likely to exhibit its effects as quickly nor in such drastic fashion as overheated wire, and may escape notice even down to the finishing size. Incomplete retention of the solid solution is invariably the result of spotty quenching or slow quenching, and the ejected product of such uncontrolled decomposition is the Gamma phase. When precipitated in this fashion, the seat of location is usually on the grain boundaries and in many cases defies resolution at medium powers of the microscope. A typical microstructure with heavy boundary pockets and fringes of this kind is that shown in Figure 4. The behaviour of this annealed structure is such that reduction, are limited and brittleness is induced at an early stage. The amount and distribution being the governing factors. The normal rapid work hardening tendencies of the alloy in cold working are accelerated by the presence of this boundary product and cases have been found where 2 or 3 holes was the limiting cold work that could be performed before excessive brittleness set in. Aside from these working habits this condition of metal state is responsible for variations encountered in heat hardening response of articles made from the wire, and every precaution must be

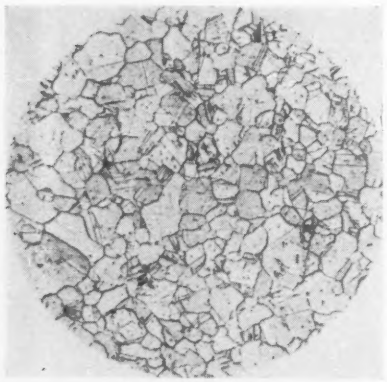

Fig. 2. Solid Solution Annealed Product. Lntd. Sec. 250 X. Etch Ammonium Hydroxide + Hydrogen Peroxide. ✦ ✦ ✦ ✦

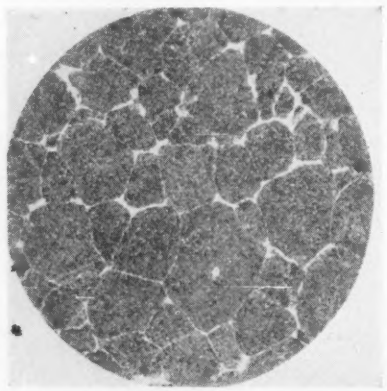

Fig. 3. Beta Membrane White due to overheating. 250 X. Etch Ammonium Hydroxide + Hyydrogen Peroxide. ✦ ✦ ✦ ✦

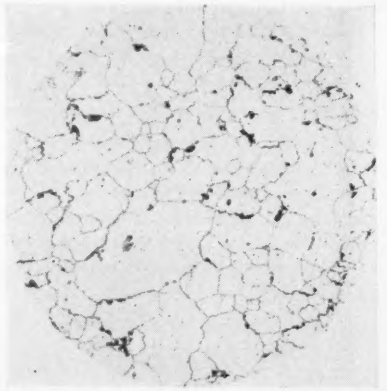

Fig. 4. Pockets of boundary precipitate. 250 X. Etch Ammonium Hydroxide + Hydrogen Peroxide. Bleach out in Dichromate. ✦ ✦ ✦

used in annealing and quenching to prevent its formation.

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Effects of Salt Baths

IN annealing beryllium-copper, salt baths have been used, but in practice have not been successful due to the rapid corrosion attack of the salt at high temperatures. This is the case in all salts tried to date either in bulk or strand practice. Figure 5 is characteristic of the pit form attack found in a strand annealed wire from a salt bath after pickling clean. Such surface conditions are prohibitive in the drawing of high quality wire.

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Homogenizing

THE annealing practice as carried out by heating in to the solution range and quenching is the conventional treatment for softening. There is, however, still another means of bringing cold worked metal to a useful working condition for further redrawing, this has become known by the colloquial term of homogenizing*. Homogenizing is carried out by heating for a prolonged time initially between 4 and 8 hours at a temperature between 1000° F. and 1040° F. The effect of this process of softening is to cause substantial precipitation of the gamma phase and its eventual spheroidization with recrystallization of the alpha matrix with a minimum of grain growth.

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THE spheroidal structure obtained (Figure 6) has excellent working characteristics and its properties as a cold drawn wire are most useful in a variety of wire products. (It can not, of course, be applied where the heat treated maximum properties of beryllium-copper are required). In the field of drawn brush wire both straight and crimped in wire forms and certain types of springs, it is increasing in use. As a process anneal the method has attractions since it is used with regular annealing equipment for handling most non-ferrous metals in mill process for redrawing. Where the metal has to be restored to a condition suitable for subsequent heat hardening the solution annealing practice is applied at the last annealing point.

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THE cold worked product (see Figure 7) from the homogenized state lends itself at high tensile levels to severe forming operations as can be seen from the table following. All wire takes the one time mandrel test or can be wrapped around itself continuously.

Diameter	Tensile
.025 smaller	170,000-185,000 psi
over .025 -.0508	155,000-170,000 psi
over .0508-.1020	145,000-155,000 psi
over .102 -.114	135,000-145,000 psi

✦ ✦ ✦

WHERE the application requires some stress, relief heating for from 15 to 30 minutes at 350°—400° F. is carried out in air oven or oil bath. Figure 8 is a comparative graph representing the cold working versus tensile increase and limit of workability on wire finished at .0280 in dry drawing. The difference in product workability is in favor of the homogenized structure.

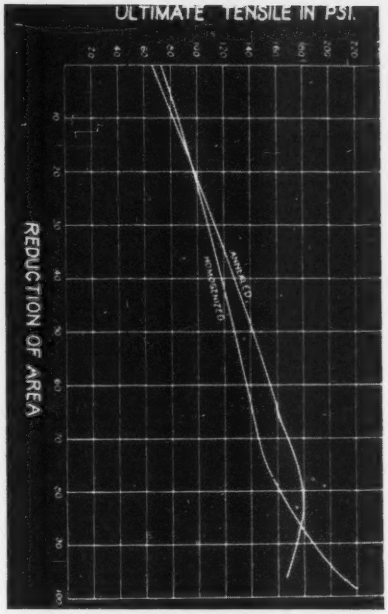


Fig. 8. Graphic Comparison of working in drawn wire. ✦ ✦ ✦ ✦ ✦

Straightening and Tempering

RECENT innovations in straightening and tempering of beryllium-copper wire continuously through strand furnaces at useful production speeds with suitable tension control enables the wire to be hardened to the highest strength levels (220,000 psi) and leaves it ductile enough for severe forming. This tempered wire has opened up further fields of use where a high strength, tough, straight non-ferrous metal is required.*

✦ ✦ ✦

THESE characteristics and their recognition have brought this difficult newcomer in the wire field to a position of importance in the wide family of the wire alloys.

* Patent rights on this product are the property of the Beryllium Corporation, Reading, Pa.

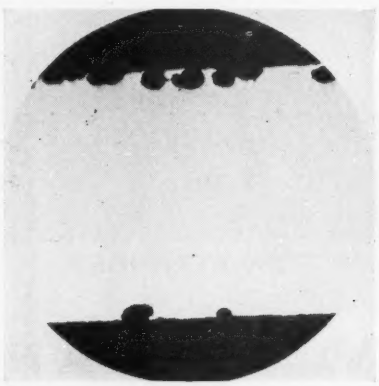


Fig. 5. Pits from Salt Bath Anneal. 150 X. No etch. ✦ ✦ ✦ ✦ ✦

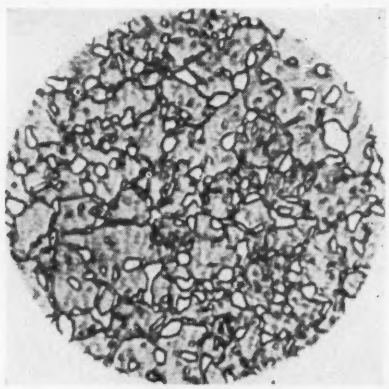


Fig. 6. Spheroidal Structure (Homogenized). 2,500 X. Etch Ammonium Hydroxide + Hydrogen Peroxide. ✦ ✦ ✦ ✦ ✦

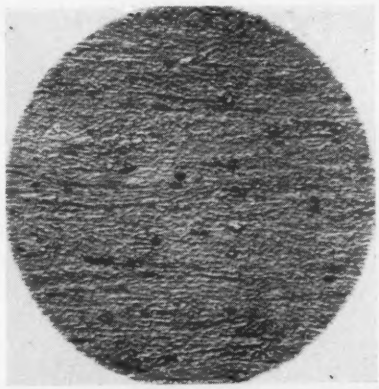
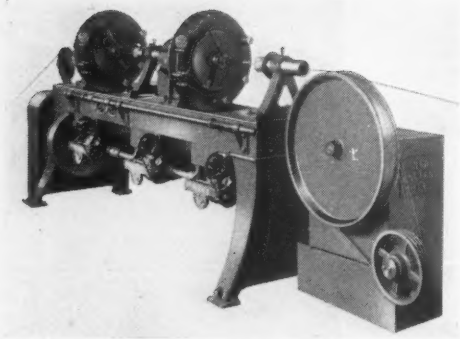
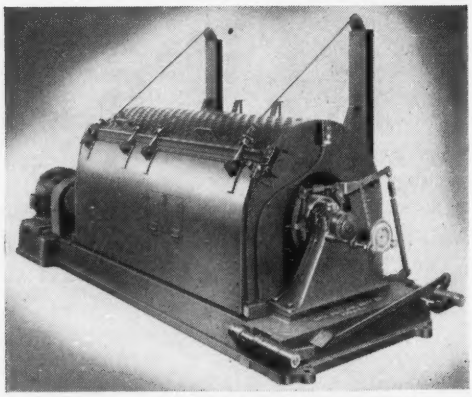


Fig. 7. Cold Drawn Structure of Homogenized metal 92½% Red. 1000 X. Etch. Ammonium Hydroxide Hydrogen. ✦ ✦ ✦ ✦ ✦

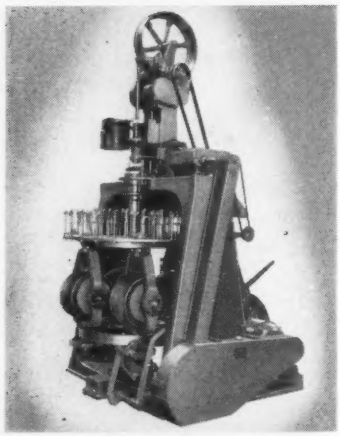
MACHINE
THE WIRE IN



TAPING MACHINE



HIGH SPEED BUNCHER



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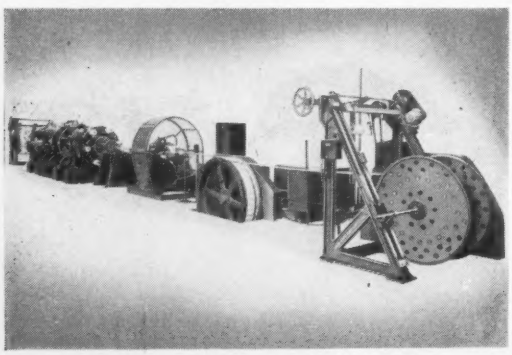
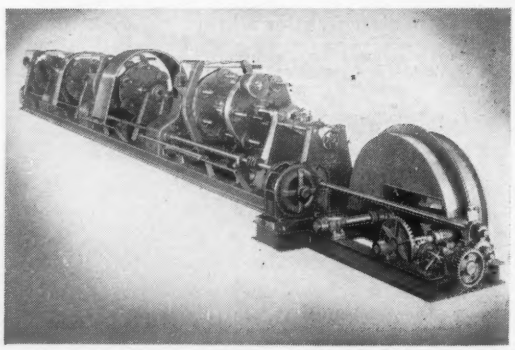


PLANETARY STRANDER



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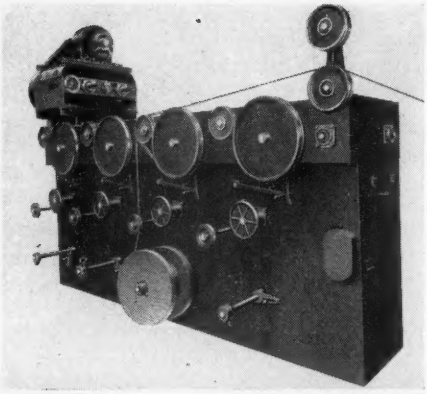
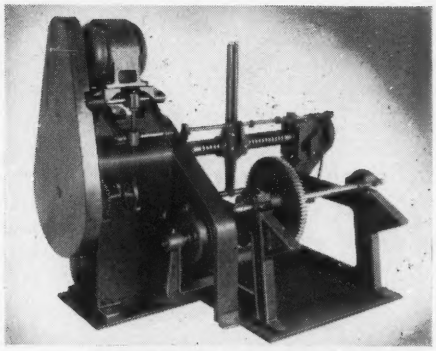


CAPSTAN TAKE UP UNIT



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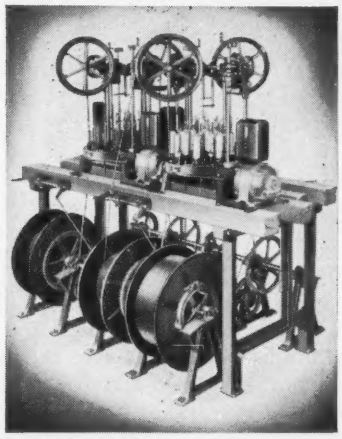
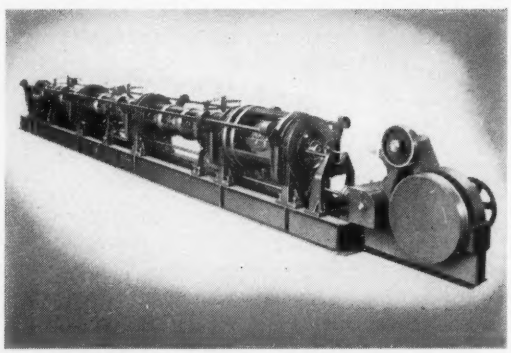
Factory tested features assure you of long, trouble-free, profitable operation.

Please send for folders on any machines you are particularly interested in.

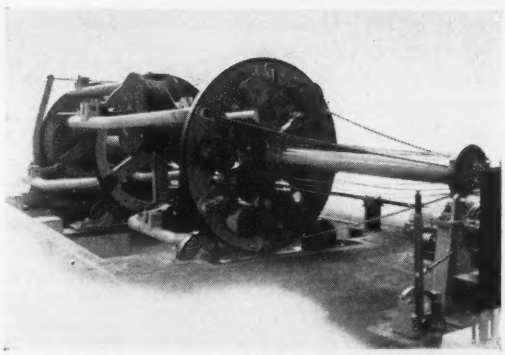
Write us about any of your wire problems—we will be glad to serve you.



BRAIDERS



HIGH SPEED STRANDER



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Insulating Wires with Vinyl Resins

By Carl L. Shapiro,

President, General Materials Research Laboratories,

Beaver Falls, Pennsylvania

The purpose of this paper is not to present a mass of procedures, charts, tables, descriptions of processes, etc., which can be obtained from the various manufacturers and suppliers of vinyl resins, but to present a concise personal version of vinyl type compound resins, their advantages, disadvantages, future trend and possibilities in the field of wire and cable insulation. ✦

Definition of Vinyl Resins

TO understand the importance and magnitude of vinyl compound resins, the prime consideration is to define "Vinyl Resins" in its technical sense and then in its limited commercial aspect. By technical definition, any organic compound having a basic structural formula of $CH_2{=}CH$ (or more broadly $CH_2{=}C<$) should be defined as a vinyl compound. Therefore, by definition, as may be seen in Table 1, vinyl type compound resins practically embrace all the important thermoplastic (softens upon heating) compounds used in the industry today.

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COMMERCIALLY, the various vinyl type compounds listed in Table I are not known entirely as vinyl resins but as separate classes of resins. The reason for this being that each separate compound has become so important from the sales angle viewpoint that they were separated into different categories, namely polyethylenes, vinyls, acrylics, styrenes, etc. Actually, however, from their mechanical and chemical properties, they should be classified into the following two classes:

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Class I—Compounds which decompose (char) when heated at elevated temperatures

THIS classification includes vinyl resins which decompose slowly by charring when subjected directly to heat at elevated temperatures. This decomposition at elevated temperatures is accelerated when the resin is in contact with metals. This decomposition rate is a function of composition, time at temperature, temperature and substance with which it is in contact. The vinyl type compounds included within Class I are vinyl acetates, vinyl chlorides, copolymers of vinyl acetate and chlorides, vinyl acetals, vinyl alcohols, vinyl butyrates, formals, etc. Other compounds included in this classification are the polyethylenes, butadienes, isobubylenes, neoprenes, synthetic rubbers, etc.

CARL L. SHAPIRO

Carl L. Shapiro, President of the General Materials Research Laboratories, Beaver Falls, Pennsylvania, and consultant to numerous companies, received his engineering education at Northeastern University, Massachusetts Institute of Technology and Harvard University. Dr. Shapiro was also director of research of the Lynnwood Laboratories, Inc.; consulting metallurgist to the Vanadium Corporation of America and assistant metallurgist of the Halcomb Division of the Crucible Steel Company of America. He was also an Andrew Carnegie Research Scholar of the Iron and Steel Institute of England; Eveleth Scholar at Harvard University and Research Associate at Harvard University. ✦ ✦ ✦ ✦ ✦

In addition to writing "The Alloys of Iron and Vanadium" Monograph for the Engineering Foundation with Mr. Jerome Strauss, Vice President of the Vanadium Corporation of America, as co-author he has published over thirty publications in chemistry and metallurgy here and abroad. At present he is a member of the American Institute of Metallurgical Engineers, Iron & Steel Institute of England, American Society for Metals, Army Ordnance Association, Mt. Sinai Lodge, Central City Consistory and Tigris Temple. ✦ ✦

Class II — Compounds Which Do Not Decompose (Char) When Heated at Elevated Temperatures but Depolymerize to Their Monomeric Conditions

VINYL compound resins of the acrylic and styrene type do not decompose by charring at elevated temperatures as do Class I compounds, but depolymerize slowly to their monomeric condition (liquid). These two compounds are the only outstanding resins that possess this property. As a consequence of this characteristic, coatings of these materials progressively become thinner when heated at elevated temperatures and eventually depolymerize without decomposition leaving a bare wire except for residual products due to the plasticization of the material. This may be illustrated effectively by stating that one pound of polymeric Class II compounds (e.g. acrylics, styrenes, etc.) can be heated at elevated temperatures (distilled) to produce approximately one pound (more exactly about 85% recovery) monomeric liquid which can subsequently be re-polymerized back again to the resin (polymer).

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Insulating Resins

AS stated in the introduction, the various methods used for insulating wires, cables, etc., will not be discussed herein. However, reference may be made to two excellent articles by Fowles ("The Properties and Uses of Vinyl Resins for Wire and Cables" WIRE AND WIRE PRODUCTS, Vol. 18, 1943, pp. 18, 615-17, 672) and Intermann ("Extrusion of Vinyl Compounds in the Wire and Cable Industry" WIRE AND WIRE PRODUCTS, Vol. 18,

1943, pp. 618-19, 622-623). Other pertinent information regarding the uses, applications, tests, etc., may be obtained from any manufacturer or supplier of vinyl compound resins.

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IN respect to insulating properties, as may be seen from Tables 2, 3 and 4, any compound possessing a CH_2=CH-grouping can almost invariably be used for insulation purposes if properly compounded and plasticized. These various resins are discussed under their respective headings — Class I and Class II, respectively.

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Class I—Acetal Types

THE history of vinyl resins is interesting in retrospect in that it shows how the industry quickly adapted and modified the available material and commercialized it. The first vinyl resin that was available in quantity was polyvinyl acetate. This resin by itself offered no improvement either over rubber insulating compounds or varnishes used for coating wire. However, when hydrolyzed by acids or alkalies, it forms polyvinyl alcohol which can be reacted with various aldehydes such as formaldehyde (Formvar), acetaldehyde (Alvar) butaldehyde (Butacite) etc., to form various polyvinyl acetals which are used extensively for various insulation purposes. Other methods of producing acetals eliminate the necessity of hydrolyzing the polyvinyl acetate to the alcohol but reacts the acetate with aldehydes directly to form acetals.

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THE properties of polyvinyl acetals vary not only with the substituent (aldehyde) group and the degree of replacement but also with the molecular weight of the polyvinyl compound modified. As a result, acetals' properties may be varied from low softening temperatures, hardness, toughness and solubility to high softening temperatures, etc., according to the above mentioned controlling factors.

✦ ✦ ✦

Chloride Type

VINYL resins of the polyvinyl or vinylidene chloride type—or copolymers of both chloride types—are also used extensively in insulating wires, cables, etc. These resins are much more corrosion resistant than the acetal but have to be more carefully compounded, plasticized, etc., to yield maximum results.

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CHLORIDE resins of the vinyl type are usually copolymerized with vinyl acetate to yield the copolymer (Vinylite). These resins vary in ratio of vinyl chloride to vinyl acetate and, as a result, are used in all types of coatings, extrusions, etc.

✦ ✦ ✦

Polyethylene Resins

A NEWCOMER which is rapidly moving to the fore in the field of insulation is polyethylene. The mechanical properties of this type resin differ essentially from those of the other vinyl type resins of Class I, in that polyethylene may be classified either as a rigid (thick section) or non-rigid (thin section) thermoplastic material depending upon section thickness. Another difference is that polyethylene possesses a crystalline structure and cold drawing

TABLE I

SOME TYPICAL VINYL COMPOUND RESINS

Structural Composition				
BASE	Additive	Complete	Chemical Name	Same Commercial Name
CH_2= CH -	H	CH_2= CH_2	Ethylene	Polyethylene, Polythene
CH_2= CH -	C l	CH_2= CHCl	Vinyl Chloride	Vinylite, Flamenol, Mipolam, Welvic
CH_2= C<	C l	CH_2= $C<^{Cl}_{Cl}$	Vinylidene Chloride	Koroseal, Geon
CH_2= CH	OH	CH_2= CHOH	Vinyl Alcohol	Vinyl Alcohol
CH_2= CH -	O.CO.CH_3	CH_2=CH-O.CO.CH_3	Vinyl Acetate	Gelva, Vinylite, Mowilith, Vinnapas
CH_2=CH- CH_2=CH-	COOH COOR	CH_2=CH-COOH CH_2=CH-COOR	Acryllic Acid) Acrylic Ester)	Lucite, Plexiglas, Acronal, Plexigum Perspex
CH_2=CH-	C_6H_5	CH_2=CH-C_6H_5	Vinyl Benzene or Styrene	Polystrene, Styron, Styraloy, Lustron, Styramic
CH_2 = CH-	CH=CH_2	CH_2=CH-CH-CH_2	Butadiene	Butadiene
CH_2= CH-	CN	CH_2=CHCN	Vinyl Cyanide	Acrylonitrile

Table 2

	TEST		ASTM TEST METHOD	POLYVINYL ACETAL PLASTICS	POLYVINYL FORMAL PLASTICS	POLYVINYL BUTYRAL PLASTICS	
						PLASTICIZED (5)	UNPLASTICIZED
ITEMS RELATING TO EASE OF FABRICATION	Compression Ratio (Bulk Factor)						
	Tabletting						
	Plasticity Range						
	Flow Temperature	°F.	D569		270 - 290		
	Moldability in Injection Molds				GOOD		
	Injection Molding Temperature	°F.			350 - 400 /	250 - 340	
	Injection Molding Pressure	psi.			10,000 - 30,000	15,000 - 30,000	
	Mold Shrinkage	ins./in.			0.002 - 0.004		
	Moldability in Compression Molds				GOOD		
	Compression Molding Temperature	°F.			325 - 350	280 - 320	
	Compression Molding Pressure	psi.			1,000 - 10,000	100 - 3,000	
	Mold Shrinkage	ins./in.			0.0015 - 0.003	0.004 - 0.02	
	Hot Forming Quality						
	Forming Temperature	°F.					
	Extruding Quality						
	Calendering Quality						
VALUES FROM MISCELLANEOUS TESTS	Specific Gravity		D71-27	1.16	1.2 - 1.3 (1)	1.05 - 1.50	1.07 - 1.20
	Machining Quality				GOOD to POOR (1)	POOR	GOOD
	Appearance						
	Clarity		D672			GOOD to EXCELLENT	GOOD
	Light Transmission	%	D672		80 - 91	85 - 91 (6)	85 - 91 (6) (A)
	Refractive Index	n_D^{25}	D542	1.46	1.5	1.48	1.48 - 1.49
	Resistance to Sunlight		D620		GOOD (3)	GOOD	
	Thermal Coefficient of Expansion Linear Per °C.		D696	6.5×10^{-5}	7.7×10^{-5} (4)	(5)	(5)
	Thermal Conductivity (cals./sq. cm./sec/°C/cm.)		D325	4.4×10^{-4}	3.7×10^{-4} (3)		
	Specific Heat	cal./gm.		0.29			
	Heat Distortion Point	°F.	D648		160 - 170 (2)		115 - 140
	Heat Resistance	°F.				(5)	(5)
	Flammability	ins./min.	D635	SLOW	SLOW (3)	(5)	SLOW
	Water Absorption — Total Water Absorption % / Solubles lost	24 hrs. %	D570	2.0	0.6 - 1.3 (3)	1.0 - 2.0	1.0 - 3.0
	Resistance to Outdoor Aging				(9)	EXCELLENT (9)	(9)
	Resistance to Indoor Aging				GOOD to VERY GOOD	EXCELLENT	GOOD
	Chemical Resistance		D543		(*)	(*)	(*)
	Weight Loss on Heating	72 hrs. at 180°F %					

(1) Plasticized materials are too thermoplastic to machine.

(2) If suitably compounded.

(3) Unplasticized material.

(4) Plasticized film yellows and embrittles, unplasticized material so affected only slightly.

(5) See data sheet for Polyvinyl Butyral Plastics for properties and values pertaining exclusively to thermosetting type, safety glass material, or rigid sheet.

(6) Kline-Bowen.

(7) Softening point 140° - 160°F.

(A) Yellows and embrittles

(9) Translucent to opaque in thicknesses other than film.

(10) Based on 0.002" film.

(11) Per A.S.T.M. D568-40.

(12) For film 1 week at 77°F. - 0.02% Water Absorption.

(13) Per A.S.T.M. D744-43T.

(14) Maximum % haze and minimum light transmission by integrating sphere method.

(15) See data sheet for Vinyl-Chloride-Acetate Resin Compositions.

produces marked increased tensile strength.

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Miscellaneous Resins

INCLUDED within this group are the synthetic rubbers which are all practically vinyl base compounds. The outstanding of these synthetic rubbers are compounds of choroprene (Neoprene), ethylene polysulphide (Thiokol) butadiene (Buna 85), butadiene and stryene (Buna S), butadiene and acrylicnitrite (Perbunan) etc. These resins or synthetic rubbers are directly related to the above and for practical purposes are of the same group (Class I) with common basic characteristics.

SUMMARY OF VALUES FOR VARIOUS VINYL COMPOUNDS

VINYLIDENE CHLORIDE (SARAN)	POLYVINYL CHLORIDE PLASTICS NONRIGID	VINYL CHLORIDE - ACETATE RESIN COMPOUNDS		POLYETHYLENE PLASTICS	METHYL METHACRYLATE		POLYSTYRENE
		RIGID TYPES	NONRIGID		CAST	MOLDING POWDER	
2						1.7 - 2.5	2.0 - 2.3
						NO	(22)
				45 - 65 (14)			(23)
285 - 305				220		330 (20)	240 - 280
EXCELLENT	GOOD TO POOR		EXCELLENT to GOOD	EXCELLENT		EXCELLENT	EXCELLENT
300 - 400	330 - 375		300 - 330	325 - 375		325 - 480	325 - 500
10,000 - 30,000	15,000 - 25,000		7,000 - 20,000	4,500 - 30,000		10,000 - 30,000	10,000 - 30,000
0.005 - 0.015	0.017			0.02 - 0.05		0.003 - 0.006	0.002 - 0.008
EXCELLENT	EXCELLENT to GOOD			EXCELLENT		EXCELLENT	(24) GOOD
220 - 350	330 - 350			250 - 320		300 - 360	275 - 375
500 - 5,000	500 - 2,000			100 - 200		1,000 - 3,000	1,000 - 10,000
0.005 - 0.015	0.017			0.02 - 0.05		0.001 - 0.005	0.002 - 0.005
GOOD					EXCELLENT		(25) GOOD
					230 - 325		190 - 250
	EXCELLENT to FAIR		EXCELLENT				
	EXCELLENT TO FAIR						(26)
1.65 - 1.72	1.18 - 1.65	1.30 - 1.60	1.15 - 1.45	0.92 - 0.93	1.18 - 1.20	1.17 - 1.19	1.05 - 1.07
GOOD					EXCELLENT	GOOD to FAIR	GOOD (27)
					EXCELLENT	EXCELLENT	
(9)	TRANSLUCENT to OPAQUE	4% HAZE (16)			1 - 3% HAZE	1 - 10% HAZE	
80 (10)		78 (17)			90 - 92	90 - 92	88 - 92 (28)
1.60 - 1.63		1.52 - 1.53		1.52	1.49	1.49	1.59 - 1.60 (28)
DARKENS SLIGHTLY	GOOD to EXCELLENT		GOOD		EXCELLENT	EXCELLENT	GOOD
19×10^{-5}				18×10^{-5}	$7 - 9 \times 10^{-5}$	$7 - 9 \times 10^{-5}$	$6 - 8 \times 10^{-5}$
2.2×10^{-4}	$3.43 - 10^{-4}$			8×10^{-4} (17)	$4 - 6 \times 10^{-4}$	$4 - 6 \times 10^{-4}$	$1.8 - 2.0 \times 10^{-4}$
0.32	0.359			0.50 - 0.53	0.35	0.35	0.31 - 0.33
150 - 180		125 - 135		115 - 122 (10)	150 - 220	135 - 200	165 - 190
160 - 200			(13) (15)		140 - 180	120 - 140	150 - 170 (17)
NONE (11)	Self Ext. to 0.60 Self Ext. to 0.90	Self Ext.	0.3 - 0.7 Self Ext. to 0.9	1.1 - 1.4	0.5 - 1.0	0.5 - 1.0	0.75 - 1.50 (17)
UNDER 0.1 (12)	0.40 - 2.25 0.10 - 2.00	0.15 MAX. 0.03 MAX.	0.1 - 1.0 0.1 - .25 (17)	0.01 - 0.09	0.4 - 0.6	0.3 - 0.6	0.04 - 0.06
DARKENS SLIGHTLY	GOOD		GOOD	NO DISCOLORATION	EXCELLENT	EXCELLENT	FAIRLY GOOD
GOOD	GOOD		EXCELLENT		EXCELLENT	EXCELLENT	EXCELLENT
(19) (21)	(19) (21)	(19) (21)	GOOD (19) (21)	(19) (21)	(19) (21)	(19) (21)	(19) (21)
	0.50 - 2.50 (13)		0.55 - 2.8 (13)				

(16) Samples 0.020" thick per A.S.T.M. D668-43.

(17) Samples 0.040" thick per A.S.T.M. D668-43.

(18) Williams plasticity at 130°C. as flow height in mils.

(20) Determined by means of Cenco-Fitch apparatus.

(22) Per A.S.T.M. D648-44T at 66 psi.

(19) For one type of heat resistant molding material.

(21) May be compressed into tablets if warmed to 170°-210°F.

(23) May be varied somewhat.

(24) Special technique should be employed to secure optimum physical properties.

(25) Can be bent, drawn, or formed into simple shapes.

(26) Depending upon type and quantity of pigment used, some additional variation may occur.

(27) Machines easily if adequately lubricated with a coolant fluid.

(28) May be varied over entire range from clear transparent to black opaque. Values shown are for clear transparent sheet 1/8" thick.

(29) Temperatures are maximum recommended for molded parts under little or no stress.

(30) Rated as slow burning per A.S.T.M. D635 and D568.

Class II—Acrylic Types

THIS class of material comprises resins obtained by the polymerization of acrylic acid ($CH_2=CH-COOH$) or esters which are commonly known as acrylates or acrylics. They possess perfect clarity, transparency, weather resistance and may combine flexibility with rigidity depending upon the substituent grouping. These vinyl type resins may be plasticized and compounded to form excellent insulators for wire, cables, etc.

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Styrene Type

AS shown in Table I, polystyrene resins also possess a vinyl type

	TEST		ASTM TEST METHOD	POLYVINYL ACETAL PLASTICS	POLYVINYL FORMAL PLASTICS (4)	POLYVINYL BUTYRAL PLASTICS	
						PLASTICIZED (6)	UNPLASTICIZED
VALUES FROM ELECTRICAL TESTS	Dielectric Strength, short time	v/mil.	D149	300 - 600 (1)	300 - 600 (1)	175 - 375 (7)	400 (7)
	Dielectric Strength, step by step	v/mil.	D149			175 - 375 (7)	400 (7)
	Volume Resistivity	ohm-cm.	D257			$5 - 10 \times 10^{13}$	OVER 10^{16}
	Surface Resistivity	ohms	D257				
	Dielectric Constant	60 Cycles	D150	3 (2)	3.6 - 3.7	5.60	3.61
	Power Factor	60 Cycles	D150	0.007 - 0.01 (5)	0.007	0.115	0.007
	Loss Factor	60 Cycles	D150		0.025 - 0.026	0.64	
	Dielectric Constant	1,000 Cycles	D150		3.3	4 - 13	3.58
	Power Factor	1,000 Cycles	D150		0.01	0.01 - 0.10	0.0075
	Loss Factor	1,000 Cycles	D150		0.033	0.29	
	Dielectric Constant	1,000,000 Cycles	D150		3.0	3.92 - 10.0	3.33
	Power Factor	1,000,000 Cycles	D150		0.02	0.02 - 0.10	0.036
	Loss Factor	1,000,000 Cycles	D150		0.06	0.24	
	Arc Resistance	Seconds	D495				
	Tendency to Track						
VALUES FROM MECHANICAL TESTS	Impact Strength, Izod, Milled Notch,	ft.lbs./in.	D256		0.5 - 1.0		0.74 - 0.82
	Impact Strength, Izod, Molded Notch,	ft.lbs./in.	D256				0.88 - 1.20 (9)
	Impact Strength, Charpy, Notched,	ft.lbs./in.	D256		1.0 - 1.5		2.5 - 9.0
	Impact Strength, Charpy, Unnotched,	ft.lbs./in.	D256				
	Yield Strength in Compression(Upper)	psi.	D695				
	Compression at Yield	%	D695				
	Yield Strength in Compression(lower)	psi.	D695				
	Compression at Yield	%	D695				
	Compressive Strength	psi.	D695				10,000
	Compression at Failure	%	D695				
	Yield Strength in Flexure	psi.	D650				
	Deflection at Yield	ins.	D650				
	Flexural Strength	psi.	D650				
	Deflection at Failure	ins.	D650				
	Yield Strength in Tension (Upper)	psi.	D638		9,000 - 17,000		
	Elongation at Yield	%	D638		4.0 - 5.0		
	Yield Strength in Tension (Lower)	psi.	D638		6,000 - 8,000		
	Elongation at Yield	%	D638		7.0 - 8.0		
	Tensile Strength	psi.	D638	8,000	9,000 - 12,000	500 - 3,000 (8)	4,000 - 8,500
	Elongation at Failure	%	D638		7 - 11	150 - 450 (8)	5 - 60
	Modulus of Elasticity in Compression	psi.	D695				
	Modulus of Elasticity in Flexure	psi.	D650				
	Modulus of Elasticity in Tension	psi.	D638		2.6×10^5		$3.5 - 4.0 \times 10^5$
	Bearing Strength	psi.					14,000 (10)
	Shear Strength						
	Rockwell Hardness		D229		M80 - M90 (3)		
	Brinell Hardness						
	Shore Hardness (Dur)		D676			10 - 100	
VALUES FROM FATIGUE TESTS	Dielectric Strength 1/8"	V/mil.	D149-36T				
	Deformation Under Load (Compression)	%	D621				
	Creep (Tension)						
	Flexure						

(1) 1/8" specimens at 0% RH and 77°F. For film .003" thick, dielectric strength is 1200 - 1600 V/mil.

(2) 77°F. and 150°F. - 0% RH.

(3) Values given are for 0% RH and 77° and 150°F. respectively.

(4) Values shown are for unplasticized film or molding material. See data sheet for other tests on plasticized material.

(5) Per A.S.T.M. E18-36.

(6) See data sheet for values pertaining exclusively to thermosetting type.

(7) Values shown for 0.125" specimens.

(8) Minimum values for various grades tested per A.S.T.M. D412-41 - Die C.

(9) 1/2" x 1/2" solid specimens used for molded notch samples and 2-1/2" x 1/2" x 1/8" for milled notch samples.

(10) Per A.S.T.M. Bulletin No. 114, January, 1942, Page 28.

(11) See data sheet for properties of Saran film.

(12) Test method not described - consult manufacturer.

(13) Inclined plane Scott Tester.

(14) A.S.T.M. D747-43T.

(15) Determined at 25°C.

(16) On specimens 0.078" thick. Tests on 0.0[illegible] (measured on insulated wire) 800 - 850 V/mil.

(17) On specimens 0.078" thick.

(18) Measurements made with #14 solid wire covered with 3/64" of insulation and after 24 hrs. immersion in water.

(19) Values at 60°F. (15.5°C.). For values at other temperatures see data sheet.

(20) Tensile Stress at 100% elongation per A.S.T.M. D412-41.

(21) Values on 1/10" specimens from sheet or 1/8" injection molded samples. Electrical data are average values and mechanical test data are minimum values.

VINYLIDENE CHLORIDE (SARAN) (11)	POLYVINYL CHLORIDE PLASTICS NON-RIGID	VINYL CHLORIDE - ACETATE RESIN COMPOUNDS RIGID TYPES (41)	VINYL CHLORIDE - ACETATE RESIN COMPOUNDS NON-RIGID	POLYETHYLENE PLASTICS	METHYL METHACRYLATE CAST (42)	METHYL METHACRYLATE MOLDING POWDER (42)	POLYSTYRENE
350 - 400 (5)	325 - 425 (14)	400 - 425	150 - 400 (5)	400 - 475 (5)	500 (5)	500 (5)	500 - 700 (5)
300 - 340 (5)	300 - 400 (17)		(43)		400 (5)	400 (5)	450 - 600 (5)
10^{14} - 10^{16}	10^{11} - $>10^{15}$ (18)	$>10^{14}$	1 - 60 x 10^{12} (44)	10^{9} - 10^{17}	OVER 10^{15}	OVER 10^{15}	10^{17} - 10^{19}
				10^{17} - 10^{19}			
3.0 - 5.0	6.2 - 6.4 (19)	3.2 - 3.3	8.1 - 8.3 (24)	2.25 - 2.30	3.4 - 3.6	3.4 - 3.6	2.5 - 2.7
0.03 - 0.08	0.097 - 0.15 (12)	0.007 - 0.010	0.050 - 0.102 (20)	0.0003-<0.0005	0.05 - 0.06	0.05 - 0.06	0.00006 - 0.0005
0.16 - 0.21	0.60 - 0.96 (12)				0.17 - 0.23	0.17 - 0.23	0.00015 - 0.0014
3.0 - 5.0	4.23 - 4.9 (12)	3.1 - 3.2	6.9 - 8.4 (24)	2.25 - 2.30	3.2 - 3.4	3.3 - 3.5	2.5 - 2.7
0.03 - 0.15	0.109 - 0.115 (12)	0.011 - 0.013	0.085 - 0.108 (20)	0.0003-< 0.0005	0.05 - 0.06	0.04 - 0.07	0.00005 - 0.0005
0.29 - 0.30	0.49 - 0.54 (12)				0.16 - 0.21	0.13 - 0.25	0.00013 - 0.0014
3.0 - 5.0		3.0 - 3.1		2.25 - 2.30	3.0 - 3.2	2.8 - 3.3	2.5 - 2.7
0.03 - 0.05		0.018 - 0.019		0.0003-< 0.0005	0.02 - 0.03	0.02 - 0.03	0.0001 - 0.0005
0.17 - 0.21					0.06 - 0.10	0.06 - 0.10	0.00025 - 0.0014
		40 - 80			NO FAILURE (37)	NO FAILURE (37)	120 - 135
					NONE	NONE	NONE
0.3 - 1.0		0.25 - 0.5		NO BREAK	0.2 - 0.6	0.2 - 0.4	0.26 - 0.60
							0.50 - 0.90
					0.4 - 0.6		0.28 - 0.40
					6.8 - 7.2	4.0 - 12.0	3.0 - 5.0
7,500 - 8,500							12,000 - 17,000
							3 - 7
							8,000 - 12,000
							10 - 15
		9,000 - 10,000			11,000-15000 (32)	9,000 - 15,000 (32)	11,500 - 17,000
					5 - 10 (29)	5 - 10 (29)	20 - 30
							NONE (34)
							NONE (34) (27)
15,000 - 17,000 (27)		7,500 - 13,000 (27)		1,500 - 1,700	12,000 - 16,000	10,000 - 19,600	4,800 - 19,000 (27)
					0.2 - 0.6	0.1 - 1.0	0.08 - 0.1 (27)
				1,400 - 1,600 (34)			NONE (34)
							NONE (34)
							NONE (34)
							NONE (34)
4,000 - 7,000 (27)	1,000 - 2,600 (8)	4,500 - 8,000	1,000 - 3,200 (8)	1,400 - 2,400 (34)	6,000 - 10,000	4,000 - 6,000	3,000 - 8,500 (8)
10 - 40 (33)	200 - 390 (8)		225 - 370 (8)	200 - 600 (34)	1 - 10	1 - 5	1.5 - 3.5 (35)
					2 - 5 x 10^{5} (11)		3.0 - 5.6 x 10^{5}
0.5 - 1.0 x 10^{5} (21)		350,000 - 380,000 (45)			3 - 5 x 10^{5} (11)		4.0 - 4.7 x 10^{5}
0.7 - 2.0 x 10^{5} (21)	1,100 - 1,400 (35)			12,000 - 14,000	3 - 5 x 10^{5} (11)		1.7 - 4.7 x 10^{5}
							(39)
				900 - 990 (37)			6,000 - 8,000
M50 - M65				R25-R35	M60 - M100 (31) (43)	M60 - M110 (39)	M65 - M95 (31)
					Approx. 18-40		20 - 30 (VI)
	70 - 90 ± 10		60 - 90 ± 10				
					400		
9.5 (18)			45 - 75 (33)	0.6 (38) 0.8		1.8 - 2.5 (37)	0.50 - 5.0
					2,000 - 3,000 (37)		

(23) 480 and 376 V/mil by short time and step-by-step tests, respectively, are average values on insulating compounds 0.075" specimens.

(22) Average values at 122°F. (50°C.)

(24) Tests on #14 wire, 2/64" wall at 77°F. See data sheet for Vinyl Chloride-Acetate Resin Compounds.

(25) 1000 gm. load at 248°F. per A.S.T.M. D734-43T.

(26) A.S.T.M. D412-41 - Die B & C.

(27) Johnson Shear jig (0.040").

(28) At 50°C. and 70°C., respectively.

(19) Arc ignites gases produced by its heat, but does not cause failure in the usual sense in that no carbonized path thru which the current passes is produced.

(30) A.S.T.M. D649-41T.

(31) Tangent.

(32) Very dependent upon timing of test cycle.

(33) 10 mm. ball 500 kg. load.

(34) At 77°F., 1750 cps psi Krouse Type.

(35) For one type of heat resistant material.

(36) Federal Specification Lp-406.

(36) This material shows no yield points in tension or flexure.

(37) Value is affected appreciably by thickness (depth) of specimen. Higher values shown are for 1/4" x 1/4" section. Lower values are for 1/2" x 1/8" section. Lowest values are for compression molded specimens.

(38) Type 2 injection molded test specimen.

(39) Three plate shear tool - 2". Federal Specification LP-406a.

(40) Federal Specification LP-406a.

(41) 2.5 mm. ball 25 kg. load.

(42) Unplasticized, unfilled resin.

TABLE 4

compound structure. These resins commercially known as polystyrenes, Loalin (Catalin) Styron or Styraloy (Dow), Lustron or Styramic (Monsanto) possess excellent mechanical, chemical and insulating properties.

✦ ✦ ✦

Class I Compounds

Defects of Vinyl Compound Resins

CLASS I compounds which include the acetals, chlorides, copolymers, polyethylenes, synthetic rubbers, etc., possess the following defects or disadvantages:

a. **Unstable at elevated temperatures and char by decomposition either directly resulting from temperature or by reaction with metals at elevated temperatures.**

b. **Most vinyl type compounds of Class I possess an unstable radical or compound which is affected by aging either at room or elevated temperatures. In the case of some synthetic rubbers, the detrimental compound is sulphur which will react with copper—when used for insulation. In the other vinyl type compounds of Class I, any polymer possessing an halide radical—especially the chloride type—will react with metals to form metallic halides or chlorides. The only compound of Class I which seems to possess stability at the normal temperatures obtained in insulating materials is polyethylene resins — with possibly some of the acetals.**

c. **If not properly compounded, plasticized or stabilized, there is always a danger of shrinkage upon repeated heating and cooling.**

d. **Excellent food for rodents, etc., that will eat bare unprotected wire (Some types of vinyl resins are used in edible foods, e.g. gums, ice cream, etc.)**

e. **Low softening temperature and hardness.**

✦ ✦ ✦

Class II Compounds

CLASS II compounds of which acrylics and styrenes are the most important have the following disadvantages:

a. **Incompatible with most resins in the solid state.**
b. **Possess poor adhesion to metals.**
c. **Aging characteristics of the harder compounds are poor.**

✦ ✦ ✦

Patent Situation of Vinyl Compound Resins

SINCE a complete discussion of the present patent situation of vinyl type compound resins for insulating applications is beyond the scope of this paper, a summary is

presented with the view of aiding those smaller enterprising companies who desire to enter the insulating resin field, but who are fearful of the patent situation. These companies have not much to fear, for although the present patent situation of vinyl resins for insulation purposes first appears rather hopeless and confusing, it is actually clear cut and offers excellent opportunities for obtaining patent protection for new and improved insulating compounds. The present patent situation appears to the writer as shown in Table 5.

TABLE 5
Present Patent Situation of Vinyl Compound Resins

Class	Type	Patent Situation
I	Acetals	Rather critical except for improvements in processing of acetals or for formation of new acetal compounds.
I	Chlorides	Straight chloride combinations rather tight with many possibilities for stabilizing, compounding, modifying, etc.
I	Copolymers of Vinyl Acetate and Chlorides	Wide Open
I	Polyethylenes	Excellent situation-open for improvements by compounding, modifying and creating new combination of resins.
I	Synthetic Rubbers	Rather critical for existing compounds but open for new inter-polymers, modifications, etc.
II	Acrylics	Wide Open
II	Styrenes	Wide Open

✦ ✦ ✦

Future of Vinyl Compound Resins

SINCE the future potentialities and possibilities of vinyl compound resins are unlimited because of their physical, chemical and mechanical properties, they will be used rapidly more and more in the insulation field and the question as to whether or not natural rubber will give vinyl compound resins competition will diminish with time. What the future trend will be is not a matter of conjecture, but is definitely toward more stable higher temperature resistant resins which will be harder and more flexible with greater mechanical and abrasive properties. This may be accomplished by any of the following methods:

1. Newer vinyl type compounds.
2. Modification of existing vinyl type compounds
   a. By chemical reactions with other base ($CH_2{=}C<$) vinyl type compounds.
   b. By chemical reactions with compounds other than vinyl type base material.
3. Further development of Class II vinyl type compounds.

✦ ✦ ✦

HOWEVER, a word of caution should be borne in mind in relation to the fact that the public is unfortunately oversold on plastics today, and consequently, should the mechanical properties and the life of the plastic fail to meet their high expectations, their natural reaction when and if it comes, may be to condemn the entire plastic industry —especially the synthetic rubbers (Class I vinyl compounds).

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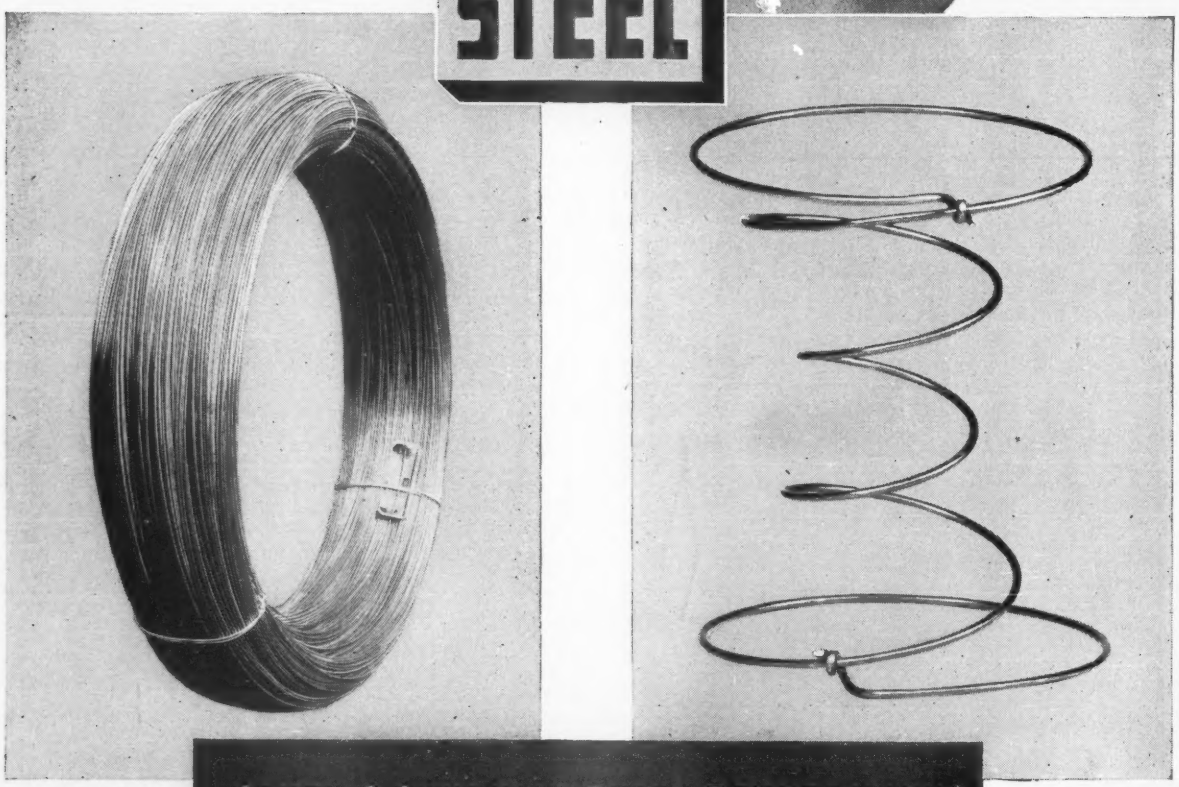

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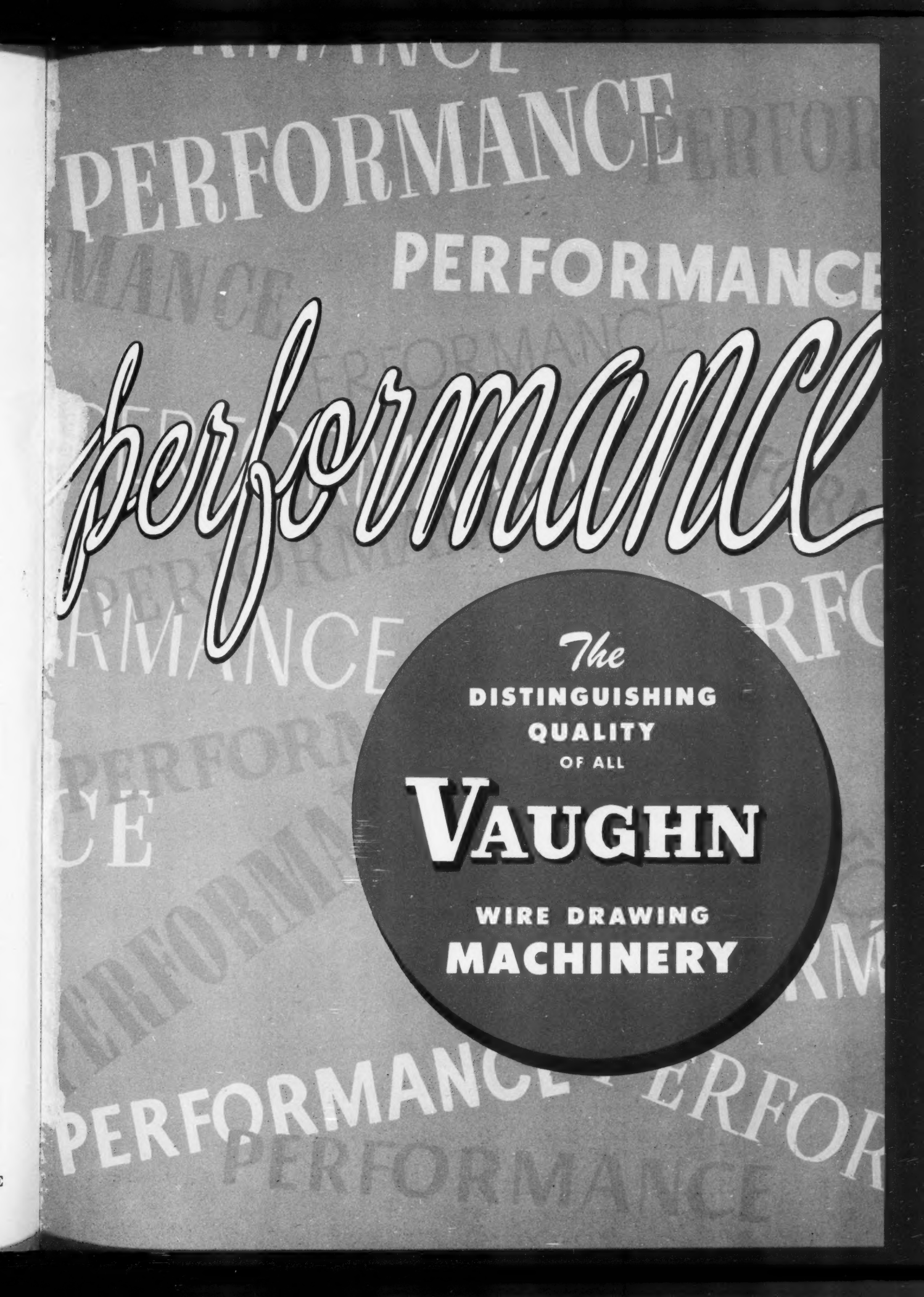
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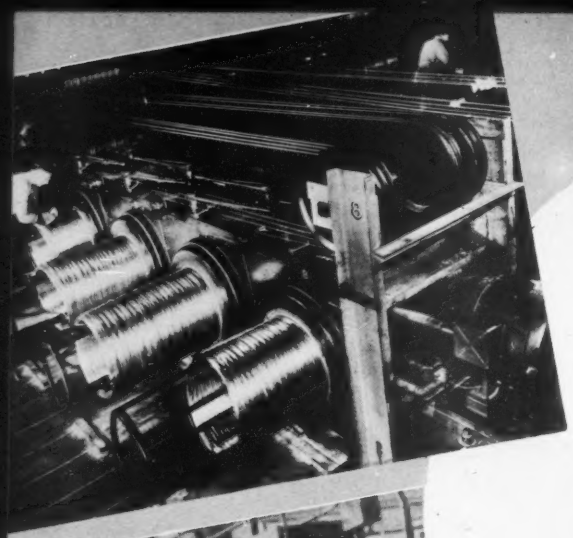

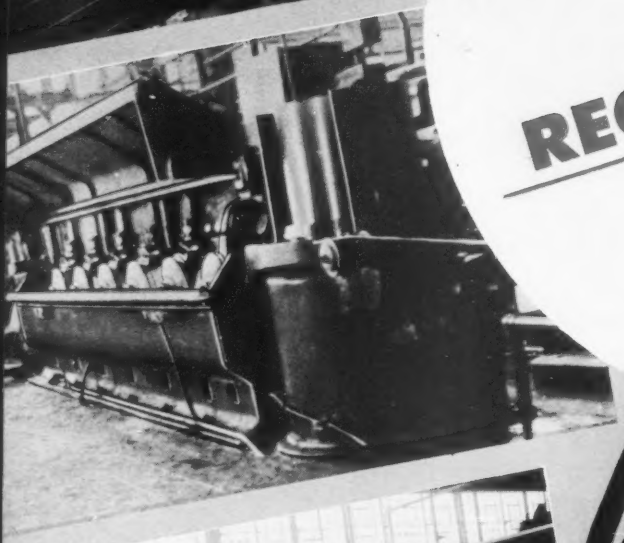

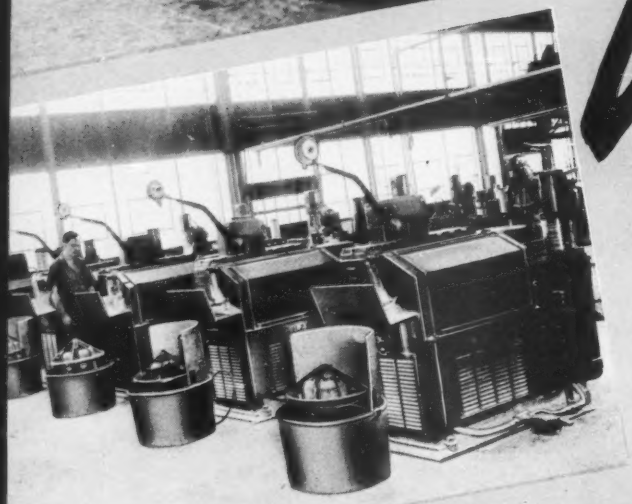

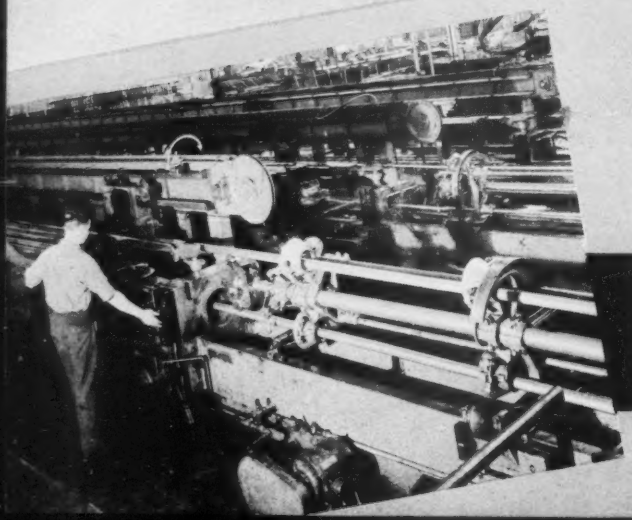

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Cleaning and De-Whiskering Nails

By N. Ransohoff

President, The Ransohoff Company, Cincinnati, Ohio

A new method of cleaning and de-whiskering nails is described. The paper prepared for presentation at the Wire Association Convention to be held in Chicago, Illinois, October, 1945. ✦ ✦ ✦

DURING the past few years under the impetus of war requirements American industry has found new ways of producing more goods with less labor. This has been true even in industries where techniques and operations have been standardized for many years.

✦ ✦ ✦

THE nail industry is one of America's oldest and methods of cleaning and de-whiskering nails have been developed over a period of years so that many nail producers would have said that there is nothing new under the nail cleaning sun.

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THE last few years, however, there has been developed a new and better way of cleaning nails and removing whiskers—a method which increases production and decreases labor costs while turning out a better product.

✦ ✦ ✦

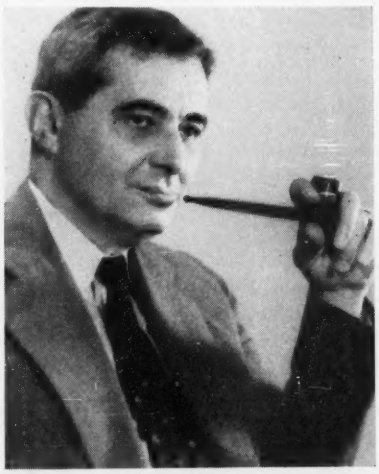
THE problem in cleaning nails is a double one. When the nails come from the dies, they are coated with a mixture of lime and with a soap used in drawing. This forms a hard tightly adhering coating which must be removed from the nail.

✦ ✦ ✦

THE second problem involved is that of removing the whiskers left by the cutting knives which point the nail. These cutting knives move on the same plane but do not quite touch each other because if they actually met they would quickly be dulled and worn out; therefore, a very thin piece of metal or whisker, as it is called in the nail industry, usually remains on the point of the nail. In a few of the more modern plants whiskers are detached in the nail forming machine. However, the nails still have to be screened from the whiskers.

✦ ✦ ✦

THE cleaning and de-whiskering operation has traditionally been performed in side loading barrels. The nails are loaded into the tumbling barrels which are then charged with sawdust. As the barrel rotates, the whiskers are taken off the nails and at the same time the sawdust plus the tumbling action removes the soap-lime coating. The barrels are equipped with blind screens which permit the whiskers and sawdust to come out of the barrel but which will not pass the nails. In this way, the whiskers and sawdust are eventually removed from the barrel and only the nails remain. The nails are then dumped onto a keg loading shaker which feeds them into the kegs. The sawdust and whiskers must then be separated from one another so that each can be disposed of to the best advantage.



N. RANSOHOFF

Born in Cincinnati Nov. 25, 1887. Received professional educaction at the Massachusetts Institute of Technology; graduated in 1910 with a degree of Bachelor of Science in Mechanical Engineering. Worked for Pratt Whitney from 1910 to 1911; Cincinnati Milling Machine from 1911 to 1913 as Production Engineer; Ideal Concrete Machinery from 1913 to 1929 as Factory Superintendent and later General Manager. From 1916 on have engaged in designing and building metal cleaning machinery. Doing this exclusively since 1929 as President of N. Ransohoff, Inc. ✦ ✦ ✦

✦ ✦ ✦

WHEN it is desired to cement coat the nails, the traditional method is to pour the lacquer over the nails while they are still in the side loading barrel and tumble until dry.

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THIS traditional method of cleaning and de-whiskering nails has a number of definite disadvantages. One of the greatest of these is the sawdust problem. Since the sawdust can be used only once, large quantities of it have to be bought and kept on hand. The sawdust itself is an expense and the storage and disposal of it in large quantities is both expensive and difficult.

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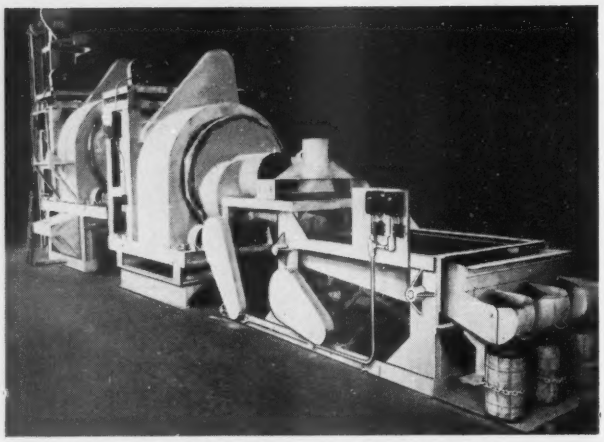
ANOTHER costly difficulty is the time required to clean the nails in sawdust. Here the entire operation is illogical because a dry barrel charged with sawdust is used to remove a hard coating which can easily be softened and removed by water. The fact that sawdust is continually being lost from the barrel thus reducing the amount of the cleaning medium and the fact that the sawdust in the barrel quickly becomes dirty simply emphasizes the inefficiency of the operation.

FINALLY, it should be noted that the traditional method requires a great deal of labor. The nails have to be loaded into the barrel and at the end of the process, unloaded. Each step requires the removal and fastening of a heavy door. Sawdust must be collected and charged into the barrel and the used sawdust must be separated from the whiskers. If the nails are cement coated there is an additional operation of putting the lacquer into the barrel, again involving the handling of a heavy door. Though some modern installations are equipped with automatic conveyors and feeding hoppers, the basic handling problems still remain.



Ransohoff Nail-Wash-Sawdust Tumble and Cement Coat Unit

✦ ✦ ✦

THE new and improved method of cleaning and de-whiskering nails reduces the labor required, speeds up the operation and results in a superior product.

✦ ✦ ✦

THIS result is obtained by a more logical handling of the process. Nails are cleaned and de-whiskered by tumbling in a hot flowing basic solution thus increasing the speed of the operation. Sawdust is used only to dry and polish the clean nails and therefore can be used over and over again. Patented automatic end loading and end unloading mills are used so that all charging and discharging operations are handled automatically save for the pushing of a button to start the whole operation and the kegging of the nails at the end.

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WHEN a batch of nails has been collected, it is charged into the first drum, either by a power loader or by a vibrating feeding hopper. The drum is equipped with a patented loading cone which prevents spillage. In this drum the nails are tumbled in a hot detergent solution which effectively removes the lime and drawing compound. The solution is recirculated from a heated tank beneath the drum by means of a specially designed Vertical Centrifugal Pump without stuffing box or packing gland and with all bearings above the solution level.

DURING the cleaning cycle the whiskers are removed and screened out through blind screens. These screens are also used to drain the detergent solution back into the heated tank beneath the drum. The whiskers are caught in a chip basket or, if they are to be prepared for sale they may be continuously removed by a drag conveyor to a rotary dryer. The nails are not only cleaned in this first drum but are also partially burnished since the nails are permitted to rub on each other while being lubricated by the detergent solution. In this way, a brighter nail is produced than is possible by the old method of sawdust tumbling. Faster cleaning is also achieved since the detergent solution softens the dirt.

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THE drum is equipped with a patented discharge head, which permits automatic discharge of the nails by simply reversing the direction of rotation. When the nails are clean and de-whiskered, therefore, the direction of the drum's rotation is reversed and the nails automatically pass out of the drum and into the second drum where they are dried and polished by tumbling in sawdust. It should be noted that the nails are clean when they reach the sawdust; therefore, the sawdust remains clean and may be used again and again. *(Please turn to page 810)*

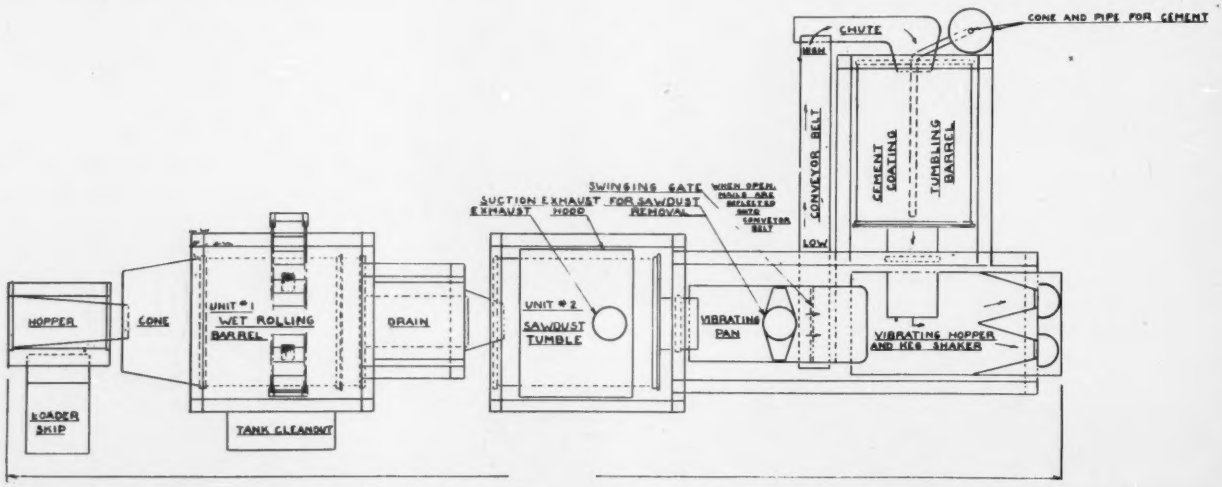

Chart of Ransohoff Nail-Wash-Sawdust Tumble and Cement Coat Unit

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Molten Baths for the Wire Industry

PART I

By F. R. Morral

Metallurgist, American Cyanamid Company, Stamford, Conn.

ABSTRACT

A review is made of the various uses of salt baths in the wire industry for cleaning, heat treating, and others. The history of fused salts as applied to the wire industry is summarized from the patent and technical literature. Properties and new work required on salt baths are outlined.

Introduction

SALT baths for the wire industry have not been considered at a symposium before in the United States. Late in April 1943 the Germans had a conference on the exchange of lead baths for fused nitrate baths for patenting wire. A general discussion of fused salts from the point of view of the American wire industry, in view of late developments, seems to be in order. Fluxes, essentially salt mixtures, used molten, are considered for completeness in this paper.

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THE functions of salt baths are various and applications for each are found in the wire industry. The fields of usefulness for ferrous and nonferrous metals are grouped and illustrated in Table 1. In general, salts are used molten in various temperature ranges from 300 to 2400° F., although in the wire industry the maximum temperature may be restricted to 2100° F. for certain wire products of the stainless steel type. Salts may be used alone or in mixtures. They may be active, taking part in certain chemical reactions, or may serve only as carriers. Occasionally other products are added which perform in a definite way; electric current may also be used. In all cases experience has shown that salt mixtures, to perform properly must meet certain standards of physical properties (grain size, humidity, melting point, etc.), chemical purity and compounding. The requirements on the salt once molten are more. Much has been written about the ideal salt bath; the ideal changing with the metal and the application. However, the following factors are necessarily required of a molten salt in its working temperature range: Inertness to work and holding pots, maintenance of its composition, no sludging, low "drag out," ease of washing, low vaporization loss, desirable cooling rate (for quenching purposes), little or no hygroscopicity at room temperature when on metal work, reasonable cost. The interest of the industry in salt baths may be gaged by the patent and the technical literature. An historical review puts in the proper perspective the developments.

DR. F. R. MORRAL

Dr. Morral received a liberal education in Spain, a B.S. in Electrochemical Engineering from the Massachusetts Institute of Technology (1932), a Ph.D. in Metallurgy from Purdue University (1940). He has been active in metallurgical research problems at the Metallografiska Institutet and University of Stockholm, Sweden (1932-1934) and at the University of Barcelona, Spain (1934-1936). He was Research Metallurgist for the Continental Steel Corporation (1937-1941). Assistant Professor of Metallurgy at The School of Mineral Industries of Pennsylvania State College, and Fellow at the Mellon Institute for Industrial Research. At the present time, he is metallurgist in charge of the Metal Trades Laboratory of the Technical Service and Development Division at the Stamford Research Laboratories of the American Cyanamid Company. ✦ ✦ ✦

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Historical

THE chronology of wire and wire products (1) has been published recently, without referring in detail to the use of molten baths. The use of salt baths in the wire industry is short, although the fundamental metallurgical principles for their use are over 200 years old.

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POLHLEM of Sweden in 1740 recommended quenching in molten lead. Mixtures of salt, saltpetre, etc., were apparently in use for various treatments of steel in the middle of the XVIII century. Use of barium carbonate for salt bath was discussed by **Caron** (2) in 1861. **McAuliffe** in 1874 (3) was granted a patent on a method of softening umbrella ribs by treating them in a bath of molten lead. In 1878, **G. Bannister** (4) hardened and tempered steel in one operation. He recommended heating the steel to the required temperature by ordinary methods and immersing while so heated in a molten bath and retaining it therein. Yet, perhaps the first patent mention of the use of salt bath may have been granted to **E. D. Wassell** (5) who submerged his metal in molten slag to reduce the carbon in the steel. Excess sodium chloride together with fused clay, or other like earthy substance bearing alumina and carbonaceous matter was proposed by **W. A. Baldwin** for the treatment of metals in 1887 (6). Annealing of wire through sand baths won a patent (7) as well as the annealing and hardening of steel rods or wire passing through two lead baths or molten metal (8). In 1900 the use of a fused cyanide together with potassium nitrate was

accepted (9). The use of fused salts for the heat treatment of tools was described in a book by **O. Thallner** in 1902 (10). **Schneider** in 1904 recommended the use of molten baths for locally softening or hardening (11). Mixtures of sodium chloride, sodium carbonate, together with ammonium chloride and also ammonium phosphate, were patented (12) for annealing metals. Molten sodium hydroxide was found to reduce the amount of carbon in cast iron (13). The use of molten cyanogen salts, such as potassium cyanide was proposed by **A. A. Hervis** (14). The **Korting Brothers** in 1904 devised an electric furnace in which the current passed through the fused salts (10). On the use of molten cyanides several patents can be found in the record, an early one being that of **E. Sweet** (15).

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THE use of molten borax was requested in 1915 (16). **H. Brearley** in his book (17) discussed salt baths in considerable detail, although he was mainly interested in their use for the treatment of tools.

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I. Cleaning Salts

U. C. **TAINTON** (18) working on electrogalvanizing of wire developed a new process of cleaning it by the use of molten caustic soda and making the work cathodic. Suitable operating conditions were said to be 850° F, a current density of 100 amps./sq. ft., and immersion time of 10 to 15 seconds. A consumption of 15# of salt per ton of wire was found. The process imparted to the steel a mild degree of resistance to rusting (19). Corrosion of pots used with molten caustic soda concerned **Perret** (20). **Evans** (21) has presented a paper on the cleaning and descaling of steel by electrolytic pickling in molten caustic soda. He recommended 425°C (797°F) and 200 amps./sq. ft. (compare with Ref. 18). The time should be adjusted according to the type of scale to be removed. Probably it should be of the order of one minute, except in the case of certain highly alloyed steels such as stainless, which may require a higher current density, or a time as long as 4 minutes.

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CAUGHERTY (22, 23), on the other hand, advocated glass processing wire and steel products for annealing and cleaning. The wire was held in molten glass at 1800 to 2400°F for 5 to 30 seconds. It emerged from the bath with a 1/32" thick coating. The metal was allowed to cool below its oxidizing temperature before glass was broken off.

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A NON-ELECTRIC process for the descaling of stainless steel in molten salt (caustic soda) has been used during the last years we have been at war (24, 25). The reducing properties of sodium hydride are used. Another molten salt process still under heavy wraps, with important possibilities for descaling special steels (tool steels, stainless, etc.), has been noted (26). These materials are heated in specially formulated molten salts based on NaOH in electric salt bath furnaces.

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A MOLTEN bath process advocated since 1937 for special processes and operated at 850 to 950°F has been developed to use current with direct and reversed polarity (27). A 6 to 12 v.d.c. current source at current densities of 8 to 50 amps./sq. ft. are used. When the work is anodic, oxidation reactions are produced on the surface, the products of which are mostly gases and therefore do not remain in the bath. Reversing the switch, the work is made cathodic. It is claimed that soluble reducing members are formed near the work surfaces. These remove mill scale as well as forging, casting, and heat treating scale.

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II. Heat Treating Salt Baths

FUSED salt mixtures had been studied previously, yet their applications to the heat treatment of steel and non-ferrous metals did not become popular until between 1917 and 1926 (10). However, no specific reference was made to wire until the last date, when the annealing of wire was discussed (28). **Bellis** in 1930 (29) was granted a patent on recuperative and regenerative heat treatment of metal wire in salt baths. **Siebe** (30) employed fused nitrate mixtures in his annealing experiments with various metal wires.

TABE I

The Functions and Uses of Salt Baths in the Wire Industry

Type Function	Applications
I. Cleaning A. Remove objectionable salts, H_2O, etc. B. Oxides	1. Molten fluxes for metal dip coating processes and brazing. In galvanizing use, sal ammoniac, zinc chloride, ammonium zinc chloride and others. 2. Fused Sodium Hydroxide a. Using electric current b. Use additions, such as Na, NaH, etc. c. Salt mixtures based on NaOH used to oxidize and reduce on metal with the aid of electric current.
II. Heat Transfer Media A. Faster than in furnaces B. No scaling	1. Annealing, normalizing, spheroidizing, tempering, solution heat treating, etc. 2. Heat to quench temperature, hardening, isothermal heat treating processes, etc. 3. Quenching media, austempering, martempering, patenting.
III. Chemical Reaction Media A. Change surface chemistry	1. Deposit on work and diffuse non-metallic elements, such as carbon in carburizing, nitrogen in nitriding. 2. Deposit on work and diffuse metals, i.e., chromizing. 3. Coloring of surface.
IV. Protective Media	1. Prevent oxidation (scaling) or reduction (such as decarburization) of surface of metal. 2. Cover for molten metals, lead, zinc, aluminum. 3. It may be possible to control the properties (oxidizing or reducing) desired for the work.
V. Combination of one or more of I to IV.	1. Simultaneous wire cleaning and heat treating. 2. Flux to clean the entering work and a protective medium over the molten coating metal. 3. Heat treating and protective medium. 4. Carburize wire followed by galvanizing.. 5. Note III-1 and III-2.

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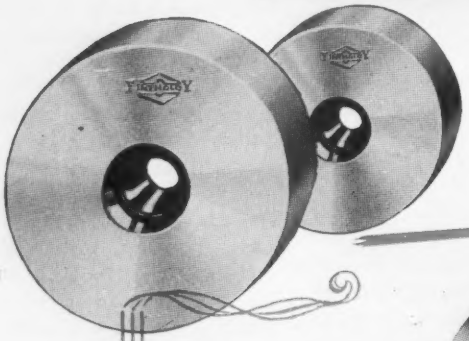

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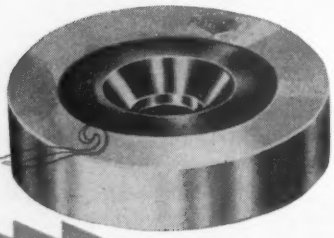

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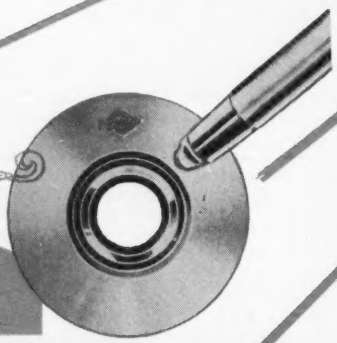

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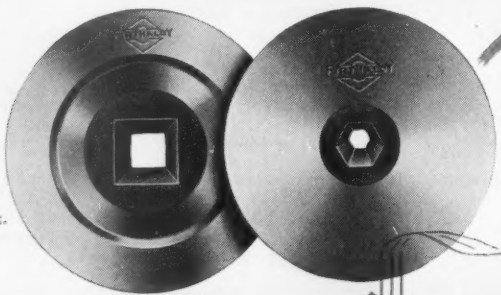

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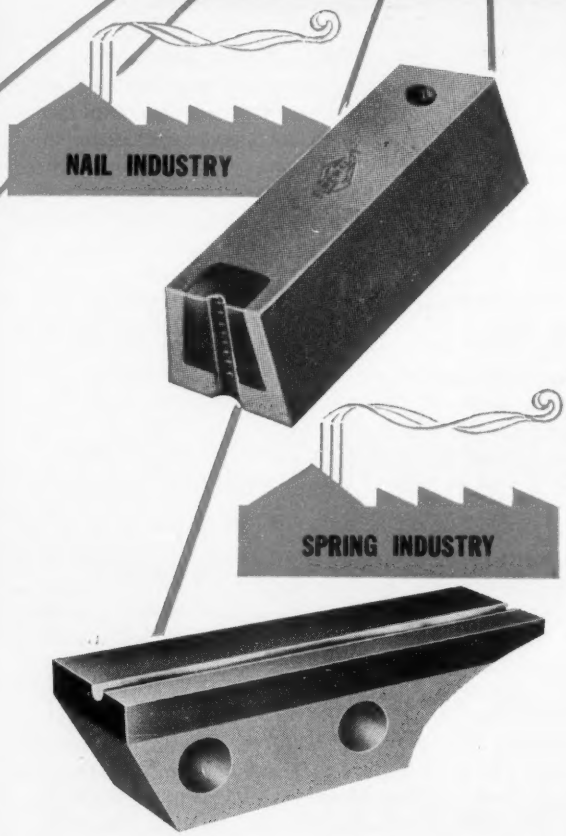

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DRAWING AND FORMING OPERATIONS

SALT bath annealing was used in the drawing of hollow SAE 4131 wire. The material was introduced at the low temperature end of the salt bath to allow salts to freeze on the work and slowly melt as parts came up to temperature (31). **White** wrote on the patenting of wire and rods (32). He discussed the quenching in lead and in salt baths. Lead dissipates heat rapidly by conduction, he concluded, salt by convection. He mentioned that advocates of salts claimed this dissipation by convection more desirable, since it adjusts itself readily to changes in mass. The rate of change through the critical range was believed to be kept uniform.

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RAISING the salt bath to a temperature of approximately 2000°F on off peak power was claimed to cut power costs in half. This process was apparently used at the A. B. & J Rathbone plant at Palmer, Mass. (33). At 7 a.m., 100# of stainless steel wire were introduced at 2000°F and allowed to cool to 1850°F. The load was removed and a 100# of pure nickel wire introduced and allowed to cool to 1650°F. 200# of German silver wire were held at between 1550 and 1400°F; 500# of steel wire between 1400 and 1250°F; 500# of brass and bronze wire were annealed at between 1250 and 1050°F; and finally aluminum wire was treated at 950°F and below to the end of the day. Small amounts of power were used during the day to keep from cooling too fast. **Merriman** wrote on the annealing of nickel silver wire in coils in salt baths at 1200 and 1450° F (34).

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UUTIL the World War was well along, the German wire mills did not become interested in the exchange of lead baths for salt baths for the patenting of wire. **Lueg** and **Pomp** (35) made a study, and to this time it is believed to be the only one made and published on the cooling power of lead, potassium nitrate, sodium nitrate, and equal part mixtures of potassium nitrate and sodium nitrate. The quenching was done from 800 and 950°C (1472 and 1742°F), and the quench baths were held at 250, 350, 450 and 550°C (482, 662, 862, and 1022° F). At temperatures of 450 and 550°C, the influence of the bath on the physical properties of the wire is small. The variation in initial wire high temperature (860-970°C or 1580-1778°F) followed by quenching at 450-550°C had no important influence upon the tensile strength of the patented product.

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JAENICHEN (36) discussed the substitution of salt baths for lead baths. He claimed best results with molten potassium nitrate, sodium nitrate, sodium nitrite and disodium chromate and their mixtures. Sodium nitrate he believed best and cheapest, giving results fully equalling those obtained with lead baths. Corrosion of the wire was negligible. In plant tests 900 tons of wire were patented with a consumption of 8.8# of salt per ton of wire.

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PELTZER (37) considered the changes which should be made in the lead bath installation to make them suitable for patenting wire in sodium nitrate. He pointed out also that a German concern had been using a salt bath as a continuous process on wire since 1937, while another by the batch process since 1913.

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A WIRE treatment was illustrated by **Babcock (38)** on a yoke of SAE 52100 which was austenitized at 1450°F in a salt bath, and then quenched into another salt bath, held at 1340°F for 4 hours to produce a structure having a Rockwell C hardness of about 14.

✦ ✦ ✦

USTL and **Schwertner** (39) discussed the use of nitrate baths for the continuous patenting of steel wire for highly stressed springs. They compared the properties of wire patented by two methods with special reference to surface defects and suitability for coiling to make special springs. In most cases wire patented in sodium nitrate baths was found to be equal to the lead patented wire. **Heidenhain** (40) wrote that many wire patenting plants in Germany had been converted from the use of molten lead to molten sodium nitrate. He experimented with external and internal resistance heating for salt baths. The former method was unsatisfactory while efficient heating was obtained by using plate electrodes immersed in the salt at opposite sides of the bath. **Suchy** (41) claimed that the patenting of steel wire in potassium dichromate gave the wire better corrosion resistance to the atmosphere or water than "air hardened" or "lead hardened" steel wire. By continuously annealing 6000# of brass per hour passing at 60 ft. per minute at 980°F, the elimination of the pickling was announced (42). A 20% saving of salt on 18 months operation was claimed. **Rath** (43) compared lead patenting with patenting in air furnaces and dip furnaces. **Tucker** (44) discussed electrode salt bath furnaces for wire, and more recently, **Stargardter** (45).

✦ ✦ ✦

LEGGE (46) has recommended that on patenting steel wire it be passed through a prequench bath at 350 to 700°F before introducing it into the quench bath at 800 to 1300° F. The purpose was to cool the steel down to the temperature of the second bath rapidly, thereby having better control on the desired microstructure.

✦ ✦ ✦

REINHARDT (47) claimed that by passing the ferrous material through sodium carbonate maintained above its melting point (1850°F), he can combine two operations in one: the annealing and the cleaning previous to galvanizing or other coating operation.

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III Various Processes

SALT baths are extensively used for carburizing and for nitriding. The subject literature in these fields is large. **Crapo** has a patent on carburizing wire previous to galvanizing (48). Articles on Fluxes used in galvanizing have been listed (49). Metal elements have also been deposited on steel to form a coating from molten salts. Because of the high temperatures used, diffusion also occurs (50). An extensive bibliography on the subject of diffusion coatings is available (51).

FOR certain processes protective atmospheres are indicated. In the Alphate process for coating steel wire with molten aluminum (52), this is a requirement. A recent patent (53) claims successful operation by the use of a salt bath cover on the molten aluminum instead. Wire at 90 ft. a minute is passed through and dipped into the molten metal at 680 to 700°C (1250 to 1292°F).

✦ ✦ ✦

USE of molten salt baths to blacken steel wire is not common, although with proper skill nitrates could be used (54). A recent development consists in treating possibly wire of stainless steel type 410 (12% Cr), 430 (17% Cr), and 304 (18-8) in a molten dichromate at between 730 to 750°F. A good .00001 inch thick, corrosion and wear resistant black coating is claimed (55).

✦ ✦ ✦

Conclusions

TABLE I summarizes the types of uses to which salt baths have been put in the wire industry. Although some are limited in tonnage, the total tonnage is extensive. For the various operations, various salts and salt mixtures are being used (56). The ideal salt bath has not been developed as yet. Work is in progress to develop new salt mixtures (57), and study their properties. The information available in the technical literature is scanty on some of these properties, such as vaporization losses, latent heats of fusion, specific heat of salt mixtures, and cooling ability on quenching at various temperatures to mention a few.

✦ ✦ ✦

THE wire industry and the metallurgical industry have enough problems of their own to try to obtain answers to the above problems. It is up to laboratories of universities and possibly of companies preparing these heat treating salts to obtain the fundamental information which will make for better use of the fused salts. Manufacturing problems such as continuous process versus the batch process has not been publicly discussed, although it is realized that tonnage is a main factor to be considered.

✦ ✦ ✦

AN expression from wire men as to their experiences, reasons for approval or disapproval, and salt bath needs in their mills would be of interest.

✦ ✦ ✦

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✦ ✦ ✦

AN annual medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

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✦ ✦ ✦

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300 MAIN STREET RICHARD E. BROWN, SECRETARY, THE WIRE ASSOCIATION STAMFORD, CONNECTICUT

Annealing High Carbon Wire Stock

By J. H. Loux,

Engineer, Salem Engineering Co., Salem, Ohio

The author discusses the importance of correct atmosphere in the prevention of decarburization, with particular reference to moisture content. Recarburization is possible with close control, but its practicality is still a moot point. ✦ ✦

THE spheroidize annealing process for high carbon steels has been a difficult and expensive process from the very first day the steels were "advanced" as the metallurgists say.

✦ ✦ ✦

TEN years ago it was considered modern practice to place the coils of high carbon wire in pit type electric furnaces. These furnaces were direct heated and were not equipped with a protective atmosphere to prevent decarburization or excessive scaling. After a complete spheroidizing cycle the wire was withdrawn and cleaned.

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THIS cleaning operation included a very costly scale breakdown. In the case of tubing, the ends of the tubes had to be plugged with clay in a somewhat unsatisfactory attempt to prevent decarburization and scale on the inside of the tube. Even then the tubes had to be sand-blasted to produce a saleable product.

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TO correct most of these faults of open annealing, hood type direct fired or radiant tube heated gas furnaces with welded steel inner covers were designed. The practice in loading these furnaces is to stack the coils of wire on spindles and to place the loaded spindles either singly or in groups on a furnace base. An inner cover is then put over the stacks of wire and a protective atmosphere gas that will prevent decarburization admitted into the cover.

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THE heating hood or furnace is immediately placed over this inner cover and the heating cycle begun.

THE protective atmosphere gas that was used in most of the installations referred to in this paper is known as a reactive gas. This gas is prepared from natural gas by a double cracking process. The CO_2 content is maintained below 2½% while the CO content may reach 16%.

✦ ✦ ✦

THIS gas can become explosive if improperly handled. On one original installation of hood type furnaces, it was desired to reload a base with coils of wire as soon as the base was free. This would save time and use the equipment to its fullest advantage. It was also decided to bleed the atmosphere gas into the inner cover as soon as the base was loaded. This was perfectly satisfactory as long as the base was cold but it was definitely not satisfactory if parts of the base were hot.

✦ ✦ ✦

IT was obvious to all concerned that as the atmosphere gas was bled into the inner cover it would mix with air in the cover and eventually form a mixture which could be ignited, and the glowing bricks in a hot base offered every opportunity to ignite this mixture of partially burned gas and air. To prevent an explosion, therefore, each base was required to stand empty for several hours while it cooled.

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AT first it was thought that four or five hours cooling time would be sufficient to lower the temperature of the brick below the ignition point. For several days the furnaces were operated on this basis. Then one day a furnace blew up.

✦ ✦ ✦

DAMAGE was slight, however. The heating hood or furnace had not yet been placed over the inner cover and the cover simply lifted about two feet off its base and all of the sand blew out of the sand seals.

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THE first step taken to prevent a recurrence was to require that the bases be cooled 7 hours instead of 5 before reloading. This slowed down production but it allowed time for all points in the brickwork of the base to cool. A visual inspection of the base was not sufficient. Even though all parts appeared cold, unless the full 7 hours cooling time was allowed, there was always the danger that the atmosphere gas would force its way down into the crevices between the tile, locate a hot spot embedded below and ignite.

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THEN suddenly, unexpectedly, almost over night, the entire hazard was eliminated. This was done by the simple addition of what is known as a Hot Purge Unit.

✦ ✦ ✦

THIS Hot Purge Unit consists of air gas mixing valves, a pump for delivering this mixture to the burner, a combustion chamber and a

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water condenser. The gas is burned at a ratio approaching perfect combustion with the oxygen content in the products of combustion maintained at zero. This gas, therefore, is absolutely non-explosive and can be mixed with any quantity of oxygen without the slightest danger.

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THE purpose of this unit is to produce a safe gas that can be used to purge all oxygen out from beneath an inner cover. This gas is then itself purged out of the furnace and replaced by the regular double cracked protective atmosphere gas.

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UNDER these conditions, a load of wire can be placed directly on a hot base. No cooling time is required. The inner cover is immediately set over the load and the hot purge gas turned into this cover. The heating hood or furnace is then placed over this inner cover and the heating cycle begun.

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DURING the first part of the heating-up cycle, constant checks are taken on the analysis of the hot purge gas as it leaves the inner cover. The purging continues until the outflowing gases show an oxygen content of less than 2%. On a large unit holding 30,000 pounds of wire this purging time may require 1½ hours.

✦ ✦ ✦

WITH this small amount of oxygen under the cover, it is then absolutely safe to admit the regular atmosphere and purge out the hot purge gas. This second purge also requires about 1½ hours.

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DURING all of this time, the load is slowly coming up to temperature. It continues coming up through both purging operations with a total elapsed time of about three hours.

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AND during this first three hours of heating, the temperature of the load is certain never to get above 1000°F. Therefore, no decarburization or scaling can take place during the two purging operations.

IN addition to the mechanics of handling the coils of wire, the inner covers, the hoods and the atmosphere gases, there is the highly important problem of how to prepare the surface of the wire before it enters the furnace so as to get the best and most consistent results.

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THE more experienced operator will insist that the surface condition of the wire before entering the furnace is all important. It is as impossible to anneal free from decarb a wire covered with rusty water or pickling compound as it is to do the job in an open fired furnace.

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THE reason is obvious. If the rust compound is allowed to break down into its component parts, these parts will immediately react on the surface of the wire and absorb the carbon from the steel.

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ONE of the best ways to assure a proper surface is to give the wire an alkali dip before placing it in the furnace. This may not be absolutely necessary but if shop practice is somewhat lax in this matter, standardizing on an alkali dip will prevent occasional losses of material.

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OVER a period of time there has been much discussion regarding the advantages of a reactive type atmosphere gas as compared to a non-reactive gas such as nitrogen.

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THE reactive type gas referred to in this paper is known to us as a double-cracked gas having an analysis of approximately 2% CO_2, 16% CO, 21% H_2, 2.2% CH_4, .0% O_2, balance N_2 dew point—50°C. This gas will react with and counteract a large quantity of impurities in the gas or on the surface of the material.

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THIS double-cracked gas is formed in a generator having two combustion chambers. The gas is caused to pass through and to burn within alloy tubes in the first chamber. Some heat is applied around the outside of these tubes. The gas leaves this unit and passes through a condenser and refrigerator before entering a second similar unit. In this second unit the gas does not burn within the tubes as much as it does within the tubes of the first unit. It is necessary, therefore, to provide more outside heat around the tubes of the second unit.

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THE gas is then passed through a second condenser and finally into a dryer. Ordinarily this double-cracked gas is manufactured from natural gas.

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THE outstanding advantages of the double-cracked gas are:

1. **That it can be used to anneal all grades of carbon steel.**
2. **That it is easily and cheaply produced. Some units have been in operation 3 years, 24 hours a day without a single shutdown. Once the ratio is set, the equipment simply produces gas. No constant analysis check or maintenance is necessary.**
3. **The gas does not form soot.**
4. **The gas is cheap, burning natural gas at a ratio of approximately 5.5—1.**
5. **It will react with and counteract a large quantity of impurities in the gas or on surface of the wire.**

✦ ✦ ✦

THE non-reactive or nitrogen gas having an analysis of approximately 96% N_2, 2% H_2, 2% CO dried to —60°C will give excellent results on most steels. Unless some methane is added, however, the gas is not able to counteract impurities that may appear in the gas or on the surface of the wire.

✦ ✦ ✦

IN one particular case where a non-reactive gas was used in the spheroidizing cycle for 52100 steel, very considerable difficulty was experienced because the gas was not put into an inner cover but was fed directly into an all-welded furnace heated by means of radiant tubes. Finally, to overcome the decarburizing effect of the impurities in the gas, on the material, and within the furnace chamber proper, a certain amount of methane was mixed with the atmosphere gas and fed in at the same time.

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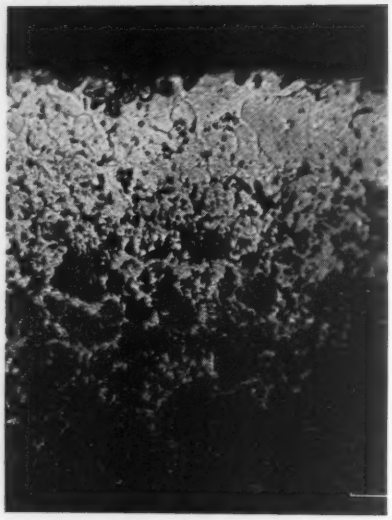
RESULTS have been satisfactory on the bar and rod stock that has been annealed. The exact



No. 1 Ground SAE 1060
1550° F. — 1 hour at temperature
Atmosphere 4.8 CO_2 — 8.6 CO
Dew Point — +60° F.
Decarb — .006 Total + Partial and .003 Total
X500 Picral Etch

amount of methane to be added is extremely critical and the entire operation requires almost as much care and constant watching as would be required in a laboratory test.

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THERE are also a number of atmosphere plants that make use of charcoal. These units provide an excellent gas for annealing free from decarburization. The approximate analysis of the gas is: 31% CO; 67% N_2, 2% H_2, dew point —40° C. Naturally, because these units burn charcoal, they require constant attention.

✦ ✦ ✦

ANOTHER atmosphere gas having an approximate analysis: 20% CO; 41% H_2; 2½% CH_4; balance N_2 dew point —40°C has certain reactive features. It is, however, more expensive to manufacture than the double-cracked gas because it operates on a ratio of about 2½—1. The gas generating machine is also more complicated and requires more maintenance than the double-cracking unit.

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ONE of the most important requirements of the double-cracked gas is that it must be dried. A dew point of minus 50° to minus 60° C. is absolutely necessary to prevent the steel from decarburizing. A wet gas with a dew point above plus 20° C. will not only decarburize but actually pit the steel.

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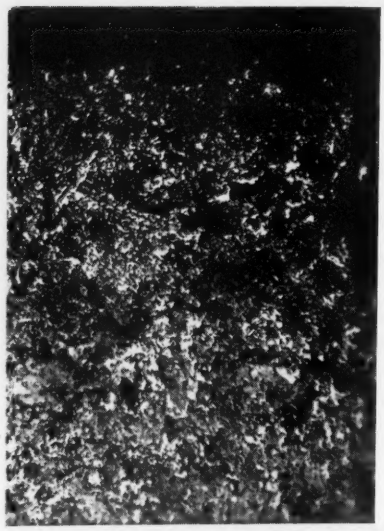
IN order to prove the important need for dry gas, a number of tests were run in our laboratory using a simple single cracked gas and the results



No. 2 Ground SAE 1060
1550° F. — 1 hour at temperature
Atmosphere 4.8 CO_2 — 8.6 CO
Dew Point — 37° F.
Decarb — Nil
X500 Picral Etch

of these are shown in the accompanying diagrams.

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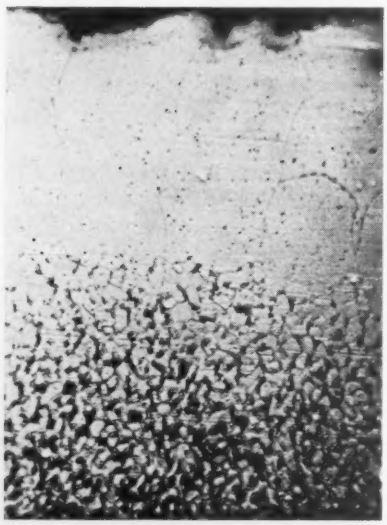
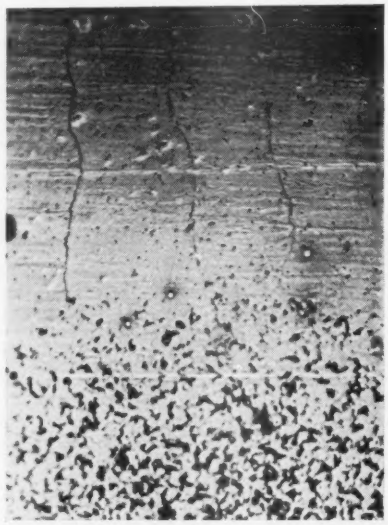
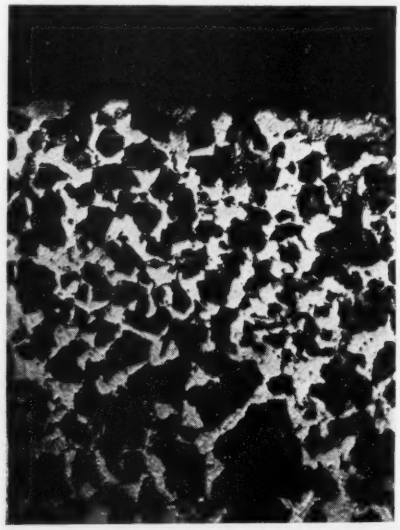
GENERALLY the cycle for annealing such steels as 6150 and 52100 is to place the material in the furnace in charges ranging anywhere from 10,000 to 30,000# each, heat up in from 12 to 15 hours, soak 2 to 6 hours and then slow cool down



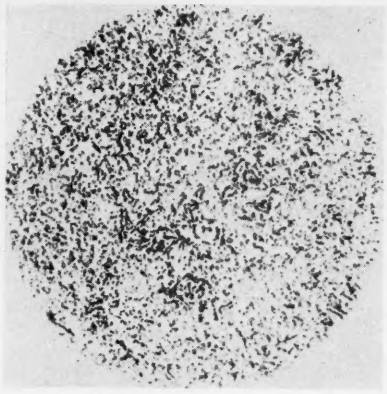
No. 3 SAE 9250
1650° F. — ½ hour at temperature
Atmosphere 4.8 CO_2 — 8.6 CO
Dew Point — +60° F.
Decarb — .008 — .010 Total + Partial and .004 — .005 Total
This material was not ground; however, decarb rating before heat treatment was .006 - .008 Total + Partial and .001 Total
X500 Picral Etch



No. 4 SAE 9250
1650° F. — 1 hour at temperature
Atmosphere 4.8 CO_2 — 8.6 CO
Dew Point + 60° F.
Decarb — .010 — .015 Total + Partial and .006 — .007 Total
This material was not ground; however, decarb rating before heat treatment was .006 — .008 Total + Partial and .001 Total
X500 Picral Etch



No. 5 Ground SAE 9250
1650° F. — 30 hours at temperature
Atmosphere 5.8 CO_2 — 9.0 CO
Dew Point — 70° F.
Decarb — Nil
X500 Picral Etch



CHROMIUM NICKEL TOOL STEEL
Cross-section of Annealed Material

No. 6		Typical Analysis
Etchant-Picric Acid	500X Mag.	C — .68
Cycle: Heat to 1400° — Hold 2 Hrs.		Mn— .60
Cool 25°/Hr. to 1250° — Fce Off		Si — .25
1150° Cover Off		P — .020
Fce Load — 40,000#		S — .020
Brinell Hardness — 179		Cr — .65
		Mo— .18
		Ni —1.35

through the lower critical at a rate varying from 5° to 30°F. per hour. Smaller charges of 4500# or less may be heated up in not more than 5 hours. The soaking and cooling rates remain the same.

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IT has been found that equipment designed for annealing 52100 steel is generally satisfactory for annealing a large variety of high carbon wire steels including bullet core stock.

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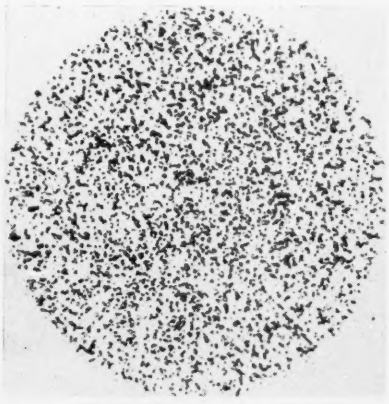
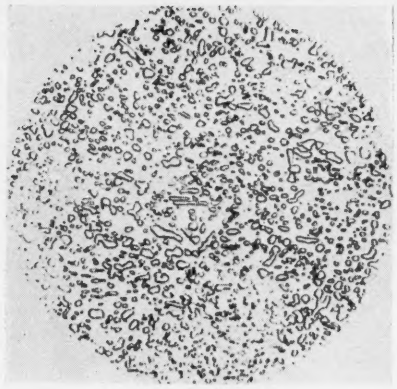
THE usual procedure is to heat the wire to approximately 25°F. above the upper critical, hold at tempera-



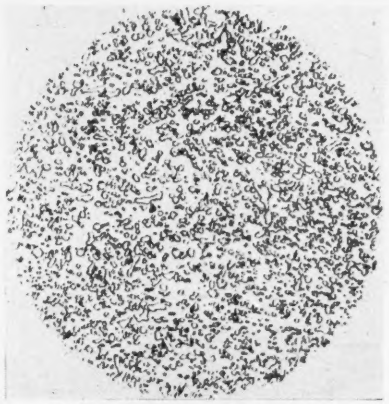
SAE 6150
Cross-section of Annealed Material

No. 10		Typical Analysis
Etchant-Picric Acid	500X Mag.	C — .50
Cycle: Heat to 1385-95° — Hold 2 Hrs.		Mn— .70
Cool 20°/Hr. to 1250° — Fce Off		Si — .25
1025° Cover Off		Cr — .95
Fce Load — 23,000#		V — .15
Coil Size — .312"		
Brinell Hardness — 84-85 Rk B		



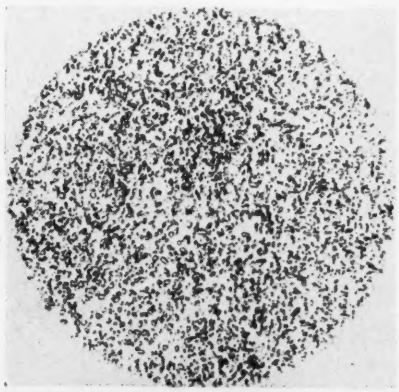
CARBON TOOL STEEL
Cross-section of Annealed Material

No. 7		Typical Analysis
Etchant-Picric Acid	500X Mag.	C —1.00
Cycle: Heat 1400° — Hold 2 Hrs.		Mn— .20
Cool 25°/Hr. to 1150° Fce Off		Si — .20
1000° Cover Off		
Fce Load — 25,000#		
Brinnell Hardness — 143		



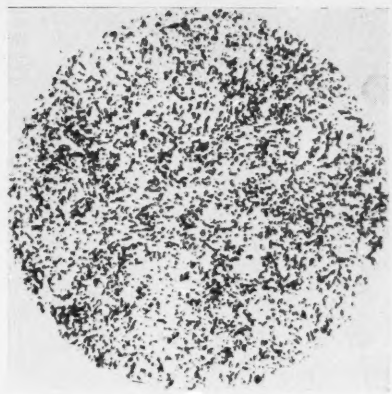
CARBON CHROMIUM TOOL STEEL
Cross-section of Annealed Material

No. 9		Typical Analysis
Etchant-Picric Acid	500X Mag.	C —1.20
Cycle: Heat to 1400° — Hold 3 Hrs.		Mn— .25
Cool 25°/Hr. to 1200°		Si — .25
Fce Off — 1100° Cover Off		Cr — .50
Fce Load — 30,000#		
Brinell Hardness — 170		



MANGANESE OIL HARDENING STEEL
Cross-section of Annealed Material

No. 11		Typical Analysis
Etchant-Picric Acid	500X Mag.	C — .90
Cycle: Heat to 1400° — Hold 3 Hrs.		Mn—1.15
Cool 25°/Hr. to 1200° — Fce Off		Si — .35
1100° Cover Off		Cr — .50
Fce Load — 30,000#		W — .50
Brinell Hardness — 170		



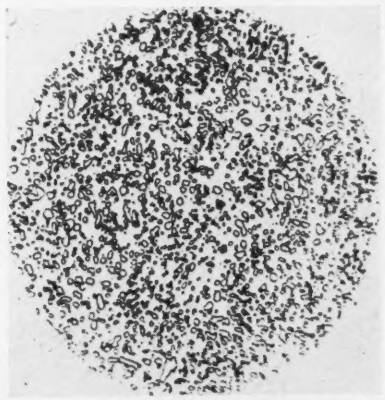
CHROMIUM MOLYBDENUM TOOL STEEL
Cross-section of Annealed Material

No. 8		Typical Analysis
Etchant-Picric Acid	500X Mag.	C — .55
Cycle: 1400° — Hold 4 Hrs.		Mn— .55
Cool 25°/Hr. to 1150°		Si — .15
Hood Off — Inner Cover Off		Cr — .65
Fce Load — 40,000#		Mo— .35
Brinell Hardness — 153		

ture, and then slow cool as described above. Some low carbon steels require a sub-critical anneal while most of the higher carbon steels require an above critical anneal.

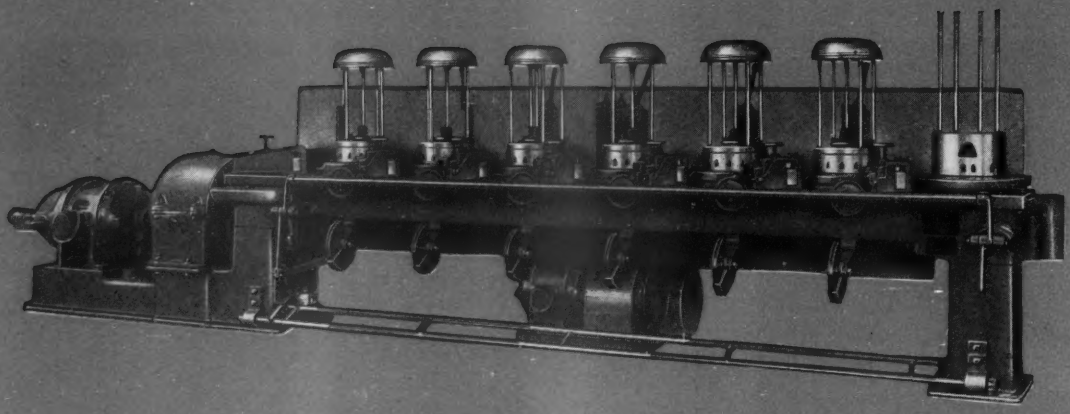
✦ ✦ ✦

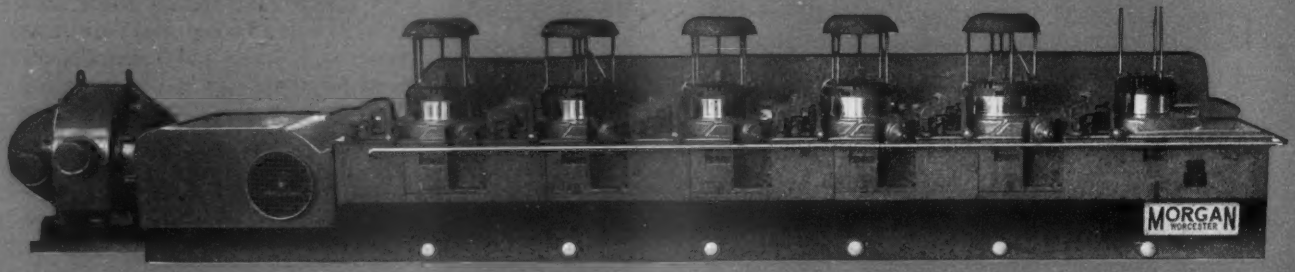
WHEN one realizes and understands that certain steels such as 6150 valve spring steel require as many as 5 draws and 5 anneals, the need for simplicity in the annealing cycle and in the annealing equipment can be appreciated. There must be no complicated parts in the atmosphere machine, none in the furnace equipment, and no complications in the operating cycle. We re-

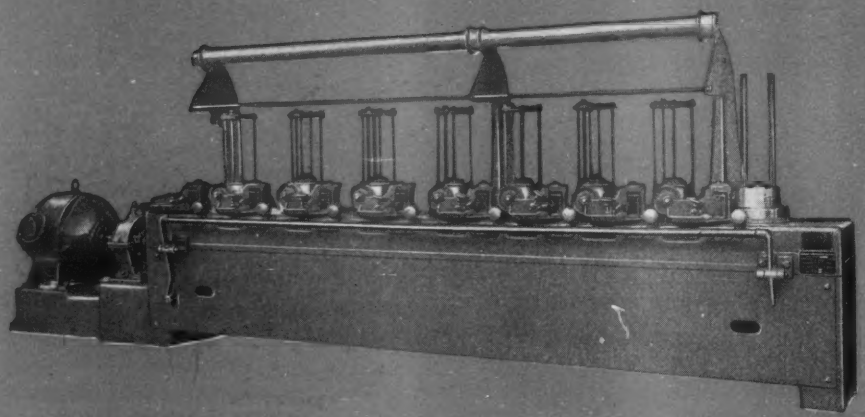


CARBON VANADIUM TOOL STEEL
Cross-section of Annealed Material

No. 12		Typical Analysis
Etchant-Picric Acid	500X Mag.	C — .85
Cycle: Heat to 1400° — Hold 3 Hrs.		Mn— .30
Cool 25°/Hr. to 1285°-1300° — Hold 2 Hrs.		Si — .25
Fce Cool to 1200° — Fce Off		V — .25
1100° Cover Off		
Fce Load — 20,000#		
Brinell Hardness — 156		







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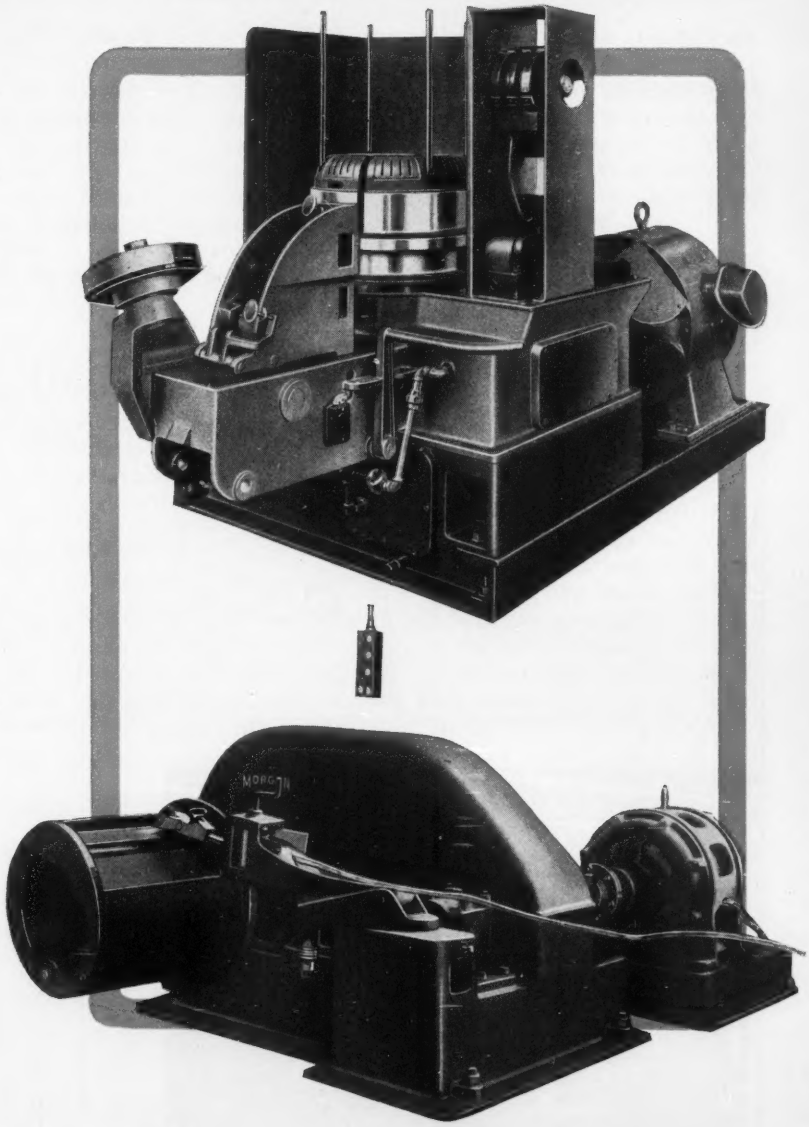

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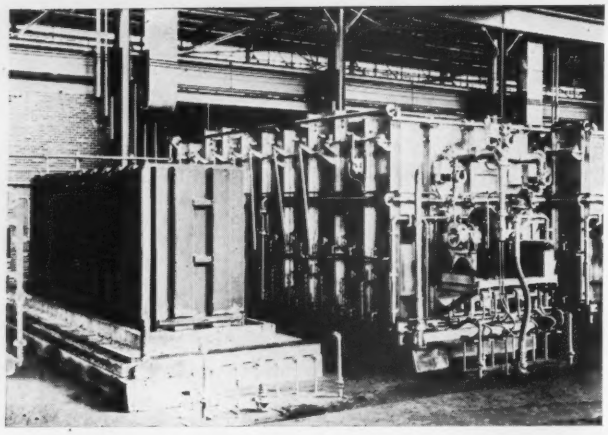
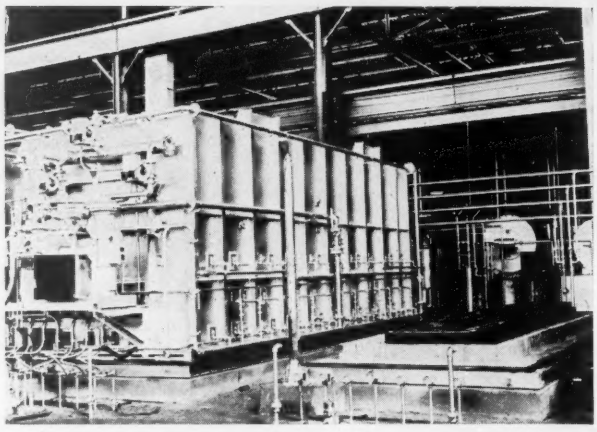




peat, that to maintain a continuous production of properly annealed wire, it is fully as important to provide the operator with simple, easily controlled equipment as it is to provide him with any modern equipment at all.

✦ ✦ ✦

THERE are times, of course, when a load of material is decarburized and ruined through some fault of the operator or some failure of the equipment. When this failure does occur, the first thought of the operator is to find some way to reclaim the material.

✦ ✦ ✦

LABORATORY tests indicate clearly that carbon can be put back into the steel by using the same double-cracked gas that is used in the annealing process. It is not as easy to do in the shop as it is in the laboratory. However, much material has been reclaimed with the shop equipment. The usual procedure is to heat the wire to approximately 1455°F. and to hold it at this temperature somewhat longer than is ordinarily done during the spheroidizing cycle. It is fairly easy under these conditions to carburize steel having no more than 60 points carbon. It is somewhat difficult under these same conditions to carburize steel having more than 60 points carbon.

✦ ✦ ✦

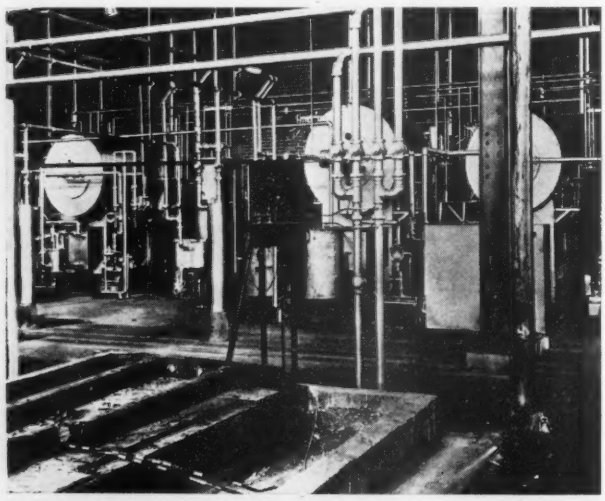
SOME operators claim, however, that the steel is not carburized at all. They call it redistribution of the carbon in the steel with the carbon in the core migrating out to the surface of the wire.

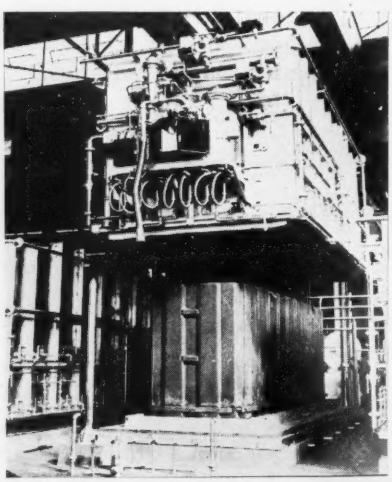
✦ ✦ ✦

ORDINARILY, the wire is removed from the protection of the atmosphere gas at about 1100°F. Naturally if it is desired to produce a clean surface, one that is as clean after annealing as it was before annealing, the cover must be left on the material until the wire cools to approximately 300°F. In the majority of cases this is not desired. The wire that must be drawn will usually function better with the drawing compound if the wire surface is not too smooth and bright.

✦ ✦ ✦

ALTHOUGH much has been said regarding the advantages of the double-cracked gas, it must be realized that a single-cracked gas having an analysis of 5% CO_2, 9% CO, 11% H_2, 3½% CH_4, balance N_2 would be quite satisfactory for annealing free from decarb if dried to minus 60°C. We say it would be satisfactory. By that we mean that there would be nothing in the gas to cause the material to decarburize except the impurities within the gas and the impurities of rusty water and pickle compound that might be left on the material. In other words, the single-cracked gas could be used





in the laboratory but it would be even more difficult and more impractical for regular use in the shop than the straight non-reactive gas such as nitrogen.

✦ ✦ ✦

THIS only confirms what has been said before about the need for equipment designed not for laboratory use but for continuous and practical use in the shop.

✦ ✦ ✦

RECENTLY a number of companies have been studying the possibility of changing the spheroidizing cycle in some manner so as to reduce the overall cycle time. Developments are being made along this line. However, most experiments indicate that if the heating-up time is reduced drastically, the soaking time will have to be increased accordingly. With a bulk load, the wire comes up to temperature uniformly and slowly. During this slow heating-up period, all of the reactions within the steel take place. Therefore, it is only necessary to maintain the load at temperature long enough to assure a uniformly heated condition. It would seem that there should be some mid-point where the advantages of the bulk load can be retained and yet the overall heating cycle reduced.

✦ ✦ ✦

THE best solution for this problem might be to use smaller furnaces with smaller loads. These could be heated in the same manner but in somewhat less time than the large loads.

✦ ✦ ✦

AT the moment, the most likely method for reducing heating-up time to a bare minimum while cutting down the holding time involves heating the material to approximately 150° above the top critical temperature. A few operators refuse to consider this cycle because of the risk of obtaining grain growth. Other operators feel that this possibility does not exist so long as they have a furnace that will not create excessive hot spots on the surface of the wire. In other words, they feel that grain growth 150° above the top critical will not be serious. But to obtain this temperature there exists the danger that certain surface points of the material might occasionally reach higher temperatures. Results would then be unsatisfactory.

✦ ✦ ✦

DEVELOPMENTS in this field are receiving considerable attention at this time. Within the next year some very interesting alterations in the spheroidizing cycles for all types of steel will undoubtedly be developed.

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THE WIRE ASSOCIATION

300 Main Street Stamford, Conn.

Pickling with Submerged Combustion

by H. N. Snowden,

Works Manager, Seneca Wire & Mfg. Co., Fostoria, Ohio

SINCE 1939, when the first paper on Submerged Combustion equipment was presented to this assembly, there has been considerable discussion as to the relative merits of this type of heating equipment. It was thought then that discussion concerning this type equipment would be an excellent manner to present the results obtained in using direct fired equipment for the purpose of heating and agitating acid pickling tanks.

✦ ✦ ✦

JUST in case the principle of the equipment has been forgotten in the intervening period, we will briefly run over its operation. Although Submerged Combustion is a development which extends back to 1887 when Brunler developed the first burner, equipment of this type was not automatically ignited and controlled until 1930 when the Submerged Combustion Company was successful in obtaining this automatic feature of direct firing equipment. At this time basic patents were taken out on the principle of underwater automatic ignition and control and since that time additional patents have been taken on the simplification and improvement.

✦ ✦ ✦

EVEN though the burner was first operated in 1930 it was not until 1937 that the first commercial burner was sold. The intervening period of seven years was used entirely in the simplification and development of the burner controls as well as the development of an acid resisting material which would withstand the rigorous corrosive conditions which pickle room equipment constantly encounters.

✦ ✦ ✦

THAT this has been successful is well born out by our own experience with this equipment. The burner is designed in such fashion that only sections need to be replaced. These sections consist of the main burner tubes and burner plate. To us this has meant rapid and economic repair with little or no loss of production time.

✦ ✦ ✦

ALTHOUGH we understand that there is a newer control than we are using, we wish to point out that the one we have consists of Mercury switches. In this particular type control the operation of this equipment is as follows:

✦ ✦ ✦

WHEN the starting button is pushed, an especially designed gas-and-air compressor is started up. The compressor delivers the products of combustion at a pressure sufficient to overcome the head of liquid in the tank. As the compressed air is purging the burner of solution the control system begins to operate. Automatically a hot wire igniter is heated to incandescence by the passage of a high amperage low voltage current, and after a predetermined time a flow of pilot gas is admitted to the burner where it is ignited. The main gas flow is then permitted to flow into the burner where it is ignited by the pilot flame. The air-gas ratio is automatically controlled to give maximum combustion efficiency. The burner might be classed as a nozzle mixing type with no possibility of back firing.

✦ ✦ ✦

THE burner plate is located beneath the solution level to insure the cooling of the combustion chamber by the surrounding liquid. The tubular combustion chamber conducts the heat and products of combustion down to and across the bottom of the tub where they are vented and distributed to give the rate of agitation desired.

✦ ✦ ✦

FOLLOWING the ignition of the main gas flame the burner controls lock themselves into a running position until the desired solution temperature is reached. The thermostat then acts to shut off the gas flow and thus stop the heat in-put. However, the control mechanism is so designed that the air continues to flow through the system to maintain a fixed rate of agitation regardless of solution temperature.

✦ ✦ ✦

WHEN the thermostat registers a demand for heat, the controls recycle to automatically establish and ignite the gas flows. With the heat in-put so controlled, the solution temperatures can be maintained as close as one-half of one degree if necessary, but for the average department, the control range is usually set at from 3 to 5F.

✦ ✦ ✦

THE combustion efficiency of these burners is high. The burners can be set to give any flue gas analysis desired. Orsat tests are run by inserting the end of a ¼ in. pipe into one of the exhaust holes in the combustion chamber and thus conducting the products of combustion to the orsat. The general practice is to set the burners for about five per cent excess air.

✦ ✦ ✦

OUR first unit purchased, was shipped to us on March 1, 1941.

This unit had a capacity of 750,000 BTU per hour and was installed in the smaller of our two straight line cleaning tanks. After this unit was installed and operated we immediately noticed a much better grade of pickled wire rod and a much greater volume of production than we had previously been able to get from this vat.

✦ ✦ ✦

SINCE we had in five months of operations gotten such excellent results from the unit, and it had withstood the action of acid so well, we immediately ordered a second unit. It was decided, however, that we would move the present unit to the large pickling vat and place a smaller unit in the vat now being heated. It took ten months for the delivery of this second unit which was installed in July 1942.

✦ ✦ ✦

THIS completed our program for the straight line pickling unit and we were very much pleased with the results obtained. The units did everything that was claimed for them.

✦ ✦ ✦

IT was then decided to purchase an additional unit for the fine wire cleaning tank. This unit was delivered in August, 1943. We now had all of the acid tanks in the plant heated by this equipment.

✦ ✦ ✦

WE had made two radical changes when we installed this equipment. First we cut out the old circle method of cleaning and installed a straight line cleaning system. Although we were not able to pickle any more yokes of wire at one time, we were able to get much more production per 8-hour shift. Our production rose from 50 tons in eight hours to 100 tons in eight hours. This production was obtained using seven yokes, each containing seven —300# coils. In addition to this increase in production, we were able to cut down the repickles which had amounted to approximately 10% of our total picking tonnage or five tons per day down to one ton per month. This alone shows considerable savings in money and time.

✦ ✦ ✦

WE are now operating at a temperature of 170° F. while with steam our normal operating temperature was approximately 190° F. We have no dilution in the steam, rather we have a concentration because of the evaporative effect of the equipment. These are our advantages in the straight line rod cleaning equipment.

✦ ✦ ✦

IN the fine wire cleaning department we have found an additional advantage over the ones mentioned previously. As you know lime clings to the surface of steel after drawing even though it is not normally seen. With Submerged Combustion, however, a reaction takes place between the CO_2, which is a product of combustion, and the lime on the steel. This reaction seems to remove the lime from the steel and precipitates it to the bottom of the tank. This is proven by the residue found in the bottom of the vat as well as the crusts which form in certain cases around the burner ports of the combustion chamber. We have been fortunate in this reaction because the lime is not sufficiently heavy to completely close up these ports although it is necessary to clean them whenever the tank is dumped.

✦ ✦ ✦

WE now have three burners in operation. The first burner was placed in operation in March, 1941 and up through August of this year has given us five years and five months of service. The second burner was placed in operation in July, 1942 which is four years and one month of service. The last burner, which was placed in the fine wire cleaning department, was installed in August, 1943 and has now given us three years service. This means a total of 12½ burner years.

IN that period we have spent, according to our records, $886.60 on parts for this equipment. These parts included igniters, combustion chamber parts as well as new tubes for one burner. We have recently ordered tubes for our second burner but we have not as yet been billed for these. Because of the increase in production in the main cleaning line we found it necessary to increase the capacity of the larger from 750,000 to 900,000 BTU/hour. This necessitated the purchase of a compressor for $640.00. This item, however, cannot be considered a maintenance repair item and we have therefore listed it separately.

✦ ✦ ✦

TO date then, each burner has cost us $70.93 per year for parts. This we do not consider to be high because of the conditions under which this equipment operates.

✦ ✦ ✦

WE understand there are now approximately 80 units in operation throughout this country and the United Kingdom. All we definitely know is the results obtained at our own plant but from our experience we have found that there are definite advantages in the proper pickling of wire rods and we can honestly say that the equipment we have in operation does offer distinct advantages in each of the three more important phases of manufacturing. Extreme agitation and controlled temperature give a uniform cleaning of better quality. The economies afforded are many. Acid costs are reduced, production is increased due to faster cleaning, which also means a lower labor handling cost per ton. Heating costs can be drastically reduced over steam. It is possible to pickle one ton of steel rods using 100 cubic feet of 1000 BTU gas. Savings accruing from these items have proved in past performances to be great enough to write off the cost of the equipment in an amazingly short time.

✦ ✦ ✦

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Measuring Wire Stiffness by Low Stress Elongation

By C. B. Shopmyer, et al,

Works Laboratory, General Electric Company, Schenectady, New York

One of the most important properties of magnet wire is its softness or windability. The purpose of this paper is to discuss in a very general way some of the methods of measuring this property and, in particular, to describe the low Stress Elongation or L.S.E. test. ✦ ✦

THE most common test is the measurement of the elongation to failure of a 10-inch sample. This is a very simple test and is widely used in specifications. Unfortunately, while this method will show the difference between very stiff wire and very soft wire, it will seldom distinguish between wire which is satisfactorily windable and that which is not. A very simple test can be made to demonstrate why this is so. If a piece of satisfactorily soft wire is stretched as little as 1 or 2 per cent, an amount which is not significant in view of the other factors which may affect the elongation, it will be found to be too stiff for many purposes.

✦ ✦ ✦

SINCE this test is not satisfactory, a number of other methods have been developed. These differ in detail but they can be divided into those which measure the resistance to bending offered by a piece of wire and those which measure the amount of spring-back after the wire has been deformed, usually by bending it over a radius. Either of these systems will be found to be much more sensitive than the elongation test, and in most cases they can be performed with relatively simple equipment. Another advantage is that the test can be seen to be comparable with the actual conditions of coil winding.

✦ ✦ ✦

THERE are, however, several objections to this type of test. The first is that the results depend to a large extent on the dimensions of the conductor, so that it is necessary to provide a tabulation of values for each size of wire. Furthermore, even if acceptable values are set up, it is still difficult to interpret results in terms of relative softness compared with other sizes. The problem is particularly difficult if rectangular sizes are to be tested, since the required value for each size can only be determined by experience.

✦ ✦ ✦

THE second difficulty is that wire usually has a curvature and frequently has a certain number of kinks in it, particularly if it has been removed from a spool, as is usually the case. It is difficult, if not impossible, to straighten the wire, and even when this is done a definite difference will usually be found in the test, depending on the direction in which the wire is bent.

C. B. SHOPMYER

Mr. Shopmyer entered the employ of General Electric in 1935 in the Magnet Wire Section of the Works Laboratory. In 1942 he was placed in charge of this Section, a position he still holds.

✦ ✦ ✦

IN tests which measure the resistance to bending, a short section of the wire is tested so that for accurate results several tests are usually necessary.

✦ ✦ ✦

IT was in an effort to overcome these difficulties that the L.S.E. test was developed by General Electric.

✦ ✦ ✦

IT is apparent that the reason for greater sensitivity of the bend testers, as compared with the elongation test, is due to the test being made on the copper in its initial condition. In other words, while some hardening of the copper takes place in the test, the amount of hardening may be not greatly more or less than that which would occur in winding a coil.

✦ ✦ ✦

IF we consider the type of tester in which the resistance to bending is measured, it is seen that one side of the wire is slightly elongated while the other side is compressed. We are actually measuring the tensile strength of the wire under conditions of very slight elongation. Unfortunately, a mathematical analysis of the forces involved is impractical because of the fact that part of the

wire is deformed beyond its elastic limit and there is progressive hardening of the copper starting at the point of greatest stress.

✦ ✦ ✦

IT is possible to overcome this difficulty and still retain the sensitivity of test by measuring the elongation in tension of a piece of wire under such conditions that the amount of work hardening is approximately that which takes place in the bend test. Furthermore, if the sample is fairly long (say 10 inches) the results are automatically averaged over this length, whereas in the bent test, only the length adjacent to the point of bend is tested.

✦ ✦ ✦

IN Fig. 1 there is plotted the result of elongating a 10-inch piece of wire of normal softness and also a sample which was somewhat stiff but still had normal elongation. It will be seen that for a time the curves follow a line which has been labeled "Elastic Deformation." Actually, the physical properties of copper are such that the position of this line is rather indefinite, but it will be found that on a short time basis, about 1400 pounds per square inch is required to elongate a 10-inch sample one mil, and that when a load is applied and quickly removed, the mils reduction in length will be about equal to the load in pounds per square inch divided by 1400.

✦ ✦ ✦

IT will also be seen that the curves depart from the elastic line at very low values of tension, and that the soft wire breaks away at a considerably lower value than the stiff wire. Furthermore, there is a very rapid increase in the load necessary to stretch the wire even with very small percentages of elongation.

✦ ✦ ✦

IF the dotted curve in Fig. 1 is examined, it will be observed that the load has been removed at intervals to show the elastic return of the wire. For practical purposes, it can be seen that the elastic recovery is proportional to the tensile strength. (The curves are affected by the time necessary to make the test.) This is important, because it means that when we have measured the tensile strength we have measured the ability of the wire to spring back after being deformed, and we have a figure which should rate wire in the same order of stiffness as a spring back type tester.

✦ ✦ ✦

AN excellent measure of softness would be the stress in pounds per square inch required to elongate a wire some fixed amount—say one-half of 1 per cent. From a practical standpoint, this test is difficult because of the fact that wire stressed beyond its elastic limit slowly flows

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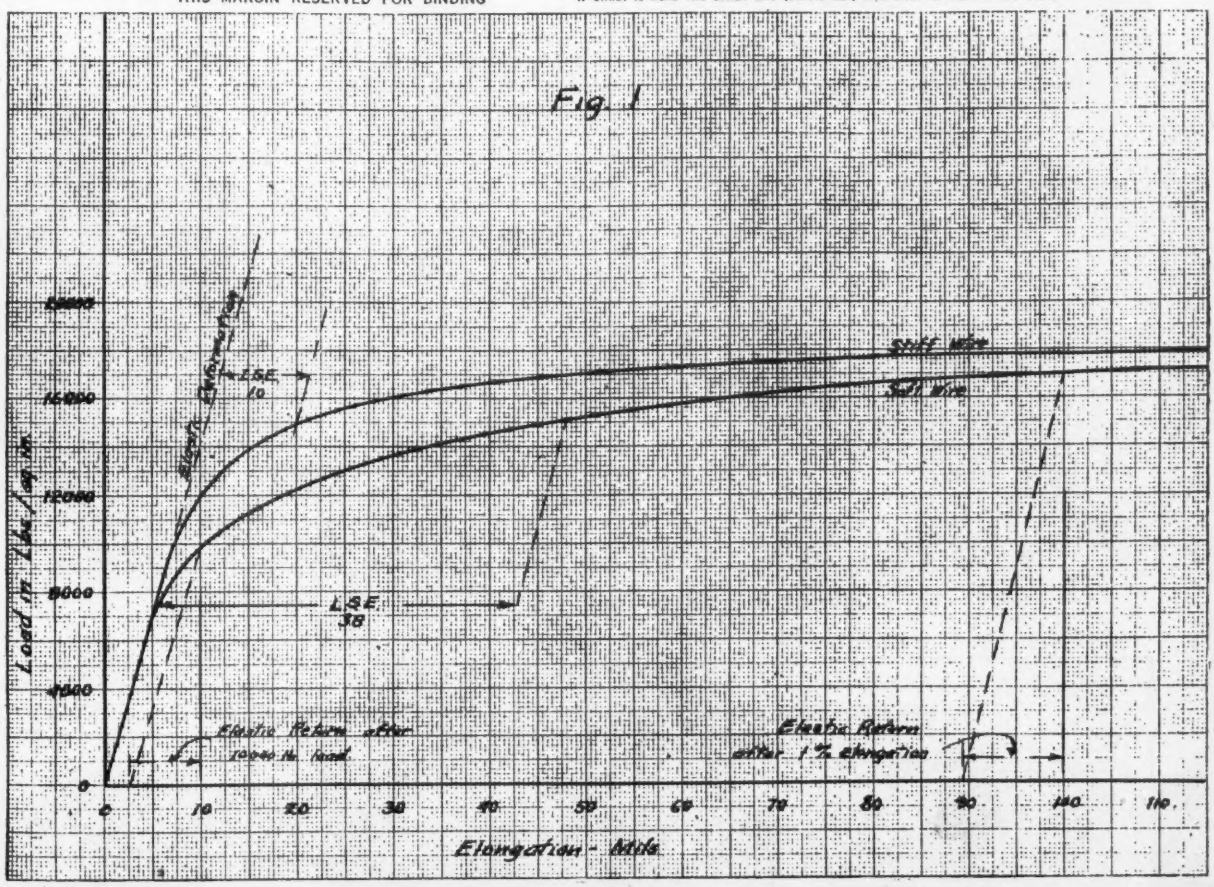

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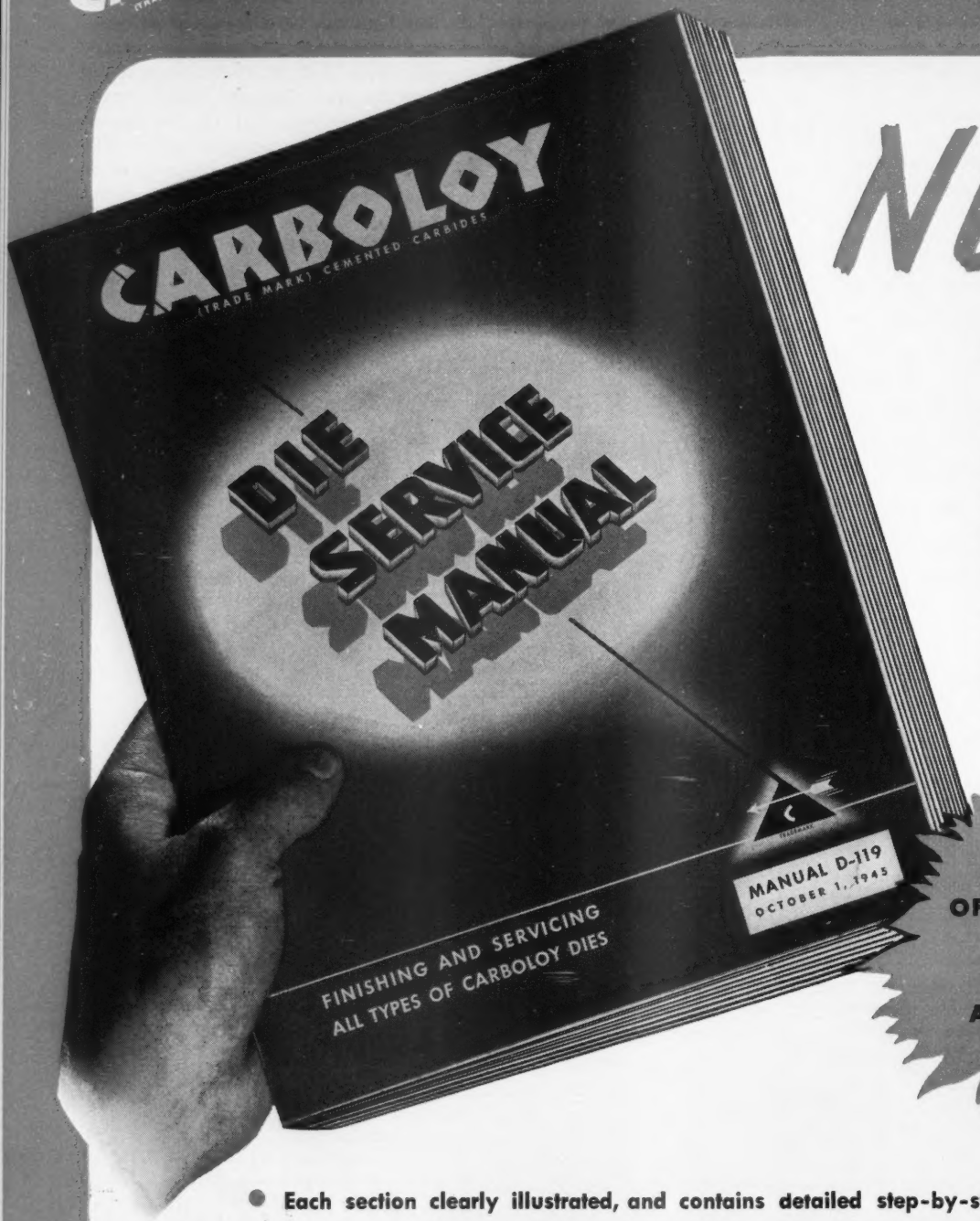

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- **Each section clearly illustrated, and contains detailed step-by-step instructions (illustrations below from page 31, Shape Die Section.)**

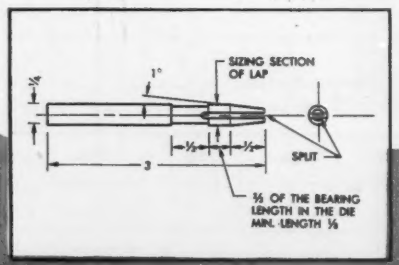

Fig. 22—Use split lap, above, for sizes ⅛" and over, to provide a "cushion" against excessive pressure.

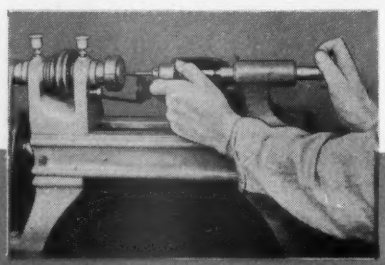

Fig. 23—Lap bearing of dies over .062" as shown above, using reciprocating motion with tailstock as a guide.

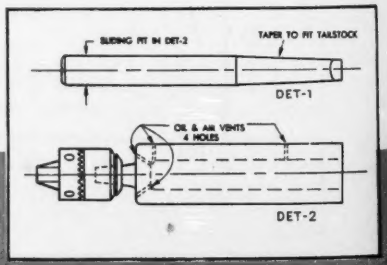

Fig. 24—Inexpensive fixture for use on dies over .062", if tailstock with reciprocating spindle is not available.

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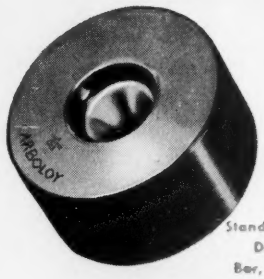
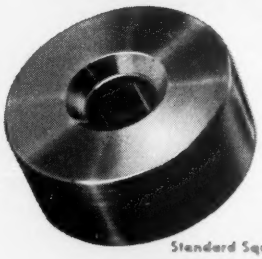


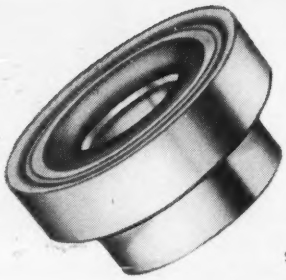
Standard Round Hole Dies for Wire, Bar, Tube Drawing

Standard Extrusion Dies

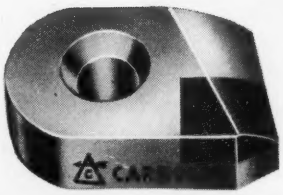
Standard Mandrels and Mandrel Nibs



Standard Square and Hex Dies



Special Round Hole Dies



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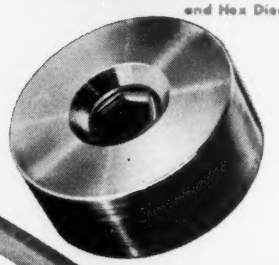
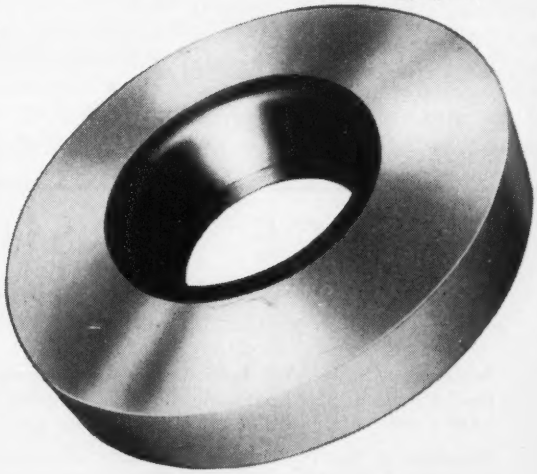


Special Shape Die

Standard Guide Rings



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and it would be difficult to predict the load which would result in a given length after a short period of time.

✦ ✦ ✦

IT was observed that at a load of 15,000 pounds per square inch any copper which could be considered soft would show some permanent set, while even very soft copper would not flow beyond the range which could be conveniently measured. With this test, the time factor could be easily taken care of by holding the load for a definite length of time (30 seconds).

✦ ✦ ✦

THE L.S.E. test may be made in a number of different ways. From the standpoint of the amount of equipment required, the following is the simplest method. It is suitable for large round and rectangular wire.

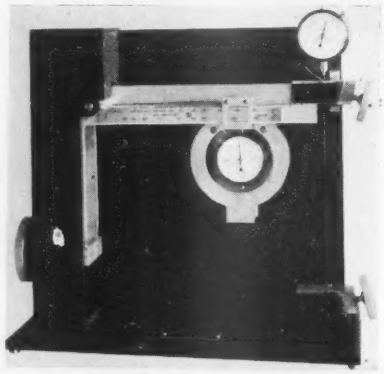
✦ ✦ ✦

A sample about 16 inches long is straightened as well as possible and marked with a bar having two knife edges exactly 10 inches apart. The sample is then placed in a tensile testing machine and loaded to a value of 15000 pounds per square inch for 30 seconds. After the load is removed, a new set of marks is made with the 10-inch bar. By means of a shop microscope, having a scale graduated in mils, it is possible to measure the permanent elongation, or L.S.E.

THE proper load on wire of any shape is readily found by cutting a piece of wire exactly 102.8 inches long. The weight of this in grams is the load in pounds necessary to give a stress of 15000 pounds per square inch. Usually it is more convenient to take 10.28 inch and multiply the resulting weight by 10.

✦ ✦ ✦

SINCE the test described is rather slow, a device was built capable of handling wire sizes from .0179 to .0808 inches (Fig. 2). In operation, a sample of wire is clamped in the jaws of the machine and the stress



G-E Low-Stress Elongation Wire Stiffness Tester

indication gauge is moved along a calibrated scale until its index coincides with the wire size being tested. At this point, the mechanical linkages are such that the stress gauge will read directly in pounds per square inch applied to the wire. When the hand-wheel, shown at the left of the illustration, is turned, the support for the load-indicating mechanism is varied and load is applied. A load of 7500 pounds per square inch is used to straighten the wire and the elongation scale is set to zero with this load applied. The load is increased to 15000 pounds per square inch and held there for 30 seconds, after which the load is again reduced to 7500 and the permanent elongation is read from the dial. Since the 7500 pounds load is within the elastic limit of most copper, the result is not affected by this procedure.

✦ ✦ ✦

ANOTHER and somewhat smaller machine has been developed for wire sizes below .0179 inches.

✦ ✦ ✦

THE test has been useful in several ways. It provides a figure for softness which can be used in specifications and which is independent of wire sizes. It is a useful tool for determining the effectiveness of annealing procedures and the hardening effect of various combinations of bending and stretching. Even more important, it has been an effective method for determining the suitability of wire for certain difficult winding jobs.

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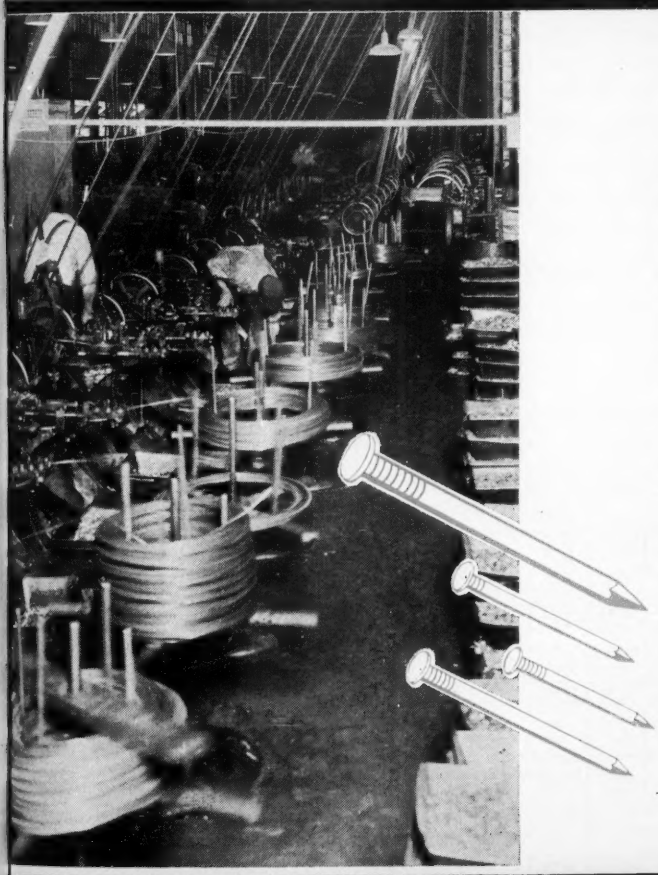

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Trends in Metallurgy

by Gustav W. Pirk,

Metallurgist, Rome Cable Corporation, Rome, N. Y.

It is the belief of the author that the time has come when wire men in general must swing away from the empirical and learn fundamentals. This paper emphasizes the increasing need for a more thorough understanding of fundamental scientific principles to general problems without getting theoretical. Physical metallurgy is the common ground on which factory and laboratory should work out the problems of production. ✦ ✦

Introduction

METALLURGY is positively and rapidly becoming a science and progressively less of an art. Empirical procedures are being replaced by rational, logical and systematic methods which are the direct evolution of the scientific method. This development is not merely a matter of academic interest or concern but is the actual basis and foundation of all future development of the metallurgical industry. In fact, the ability of any one manufacturer to retain his competitive position and realize a profit from his operations will depend to a progressively greater degree upon the extent of his basic and fundamental knowledge of the materials and processes that he utilizes in his business.

SCIENCE is the direct medium which will liberate the metallurgical industry from the inefficient and traditionally revered methods that are still adhered to in some fields. Empirical methods are always associated with loss of money and more dangerously, loss of time, which eventually may terminate in loss of competitive position and thus in the economic disintegration of an enterprise. A clear understanding of the basic principles underlying any process will lead directly to a more efficient and intelligent control of that process, thus reducing loss due to both waste of time and money. Briefly, this leads to the conclusion that the primary requisite for future industrial development and security is a thorough and comprehensive understanding of the basic principles underlying a given enterprise. Economic security and substantial competitive stability will come in fullest measure to that group which can intelligently and effectively apply scientific principles to its operations and thereby increase its efficiency and the quality of its products. Be-

TABLE 1. PERIODIC SYSTEM OF THE ELEMENTS

I_A	II_A	III_A	IV_A	V_A	VI_A	VII_A	Transition elements	I_B	II_B	III_B	IV_B	V_B	VI_B	VII_B	$VIII_B$
1 H 1.008 ⬡															2 He 4.003
3 Li 6.94 ⊡	4 Be 9.02 ⬡	5 B 10.82 ⬡	6 C 12.01 ⬡										Non-metals		
11 Na 22.997 ⊡	12 Mg 24.32 ⬡	13 Al 26.97 □	14 Si 28.06 ◫									7 N 14.008 ⊡	8 O 16.000 ⬭	9 F 19.00	10 Ne 20.183 □
												15 P 30.98 ⊡	16 S 32.06 ⊙	17 Cl 35.457	18 A 39.944 □
19 K 39.096 ⊡	20 Ca 40.08 □	21 Sc 45.10	22 Ti 47.90 ⬡	23 V 50.95 ⊡	24 Cr 52.01 ⊡(α)	25 Mn 54.93 □*	26 Fe 55.85 ⊡(α)	27 Co 58.94 ⬡(β)	28 Ni 58.69 □(β)	29 Cu 63.57 □	30 Zn 65.38 ⬡	31 Ga 69.72 ⊙	32 Ge 72.60 ◫	33 As 74.91 ⬭	34 Se 78.96 ⬡	35 Br 79.916	36 Kr 83.7 □
37 Rb 85.48 ⊡	38 Sr 87.63 □	39 Y 88.92 ⬡	40 Zr 91.22 ⬡	41 Cb 92.91 ⊡	42 Mo 95.95 ⊡	43 Ma ⬡	44 Ru 101.7 ⬡	45 Rh 102.91 □	46 Pd 106.7 □	47 Ag 107.88 □	48 Cd 112.41 ⬡	49 In 114.76 □	50 Sn 118.70 ⊡	51 Sb 121.76 ⬭	52 Te 127.61 ⬡	53 I 126.92 ⊙	54 Xe 131.3 □
55 Cs 132.91 ⊡	56 Ba 137.36 ⊡	57 71 Rare earths see below	72 Hf 178.6 ⬡	73 Ta 180.88 ⊡	74 W 183.92 ⊡	75 Re 186.31 ⬡	76 Os 190.2 ⬡	77 Ir 193.1 □	78 Pt 195.23 □	79 Au 197.2 □	80 Hg 200.61 ⬭	81 Tl 204.39 ⬡	82 Pb 207.21 □	83 Bi 209.0 ⬭	84 Po ▱	85? 212 (?)	86 Rn 222.0
87? 223 (?)	88 Ra 226.05	89 Ac 227	90 Th 232.12 □	91 Pa 231	92 U 238.07 ⬭												

Light metals — Strong electropositive metals — High-melting heavy metals — Low-melting heavy metals — Non-metals — Inert gases — NON-METALS

Rare earths:	57 La 138.92	58 Ce 140.13	59 Pr 140.92	60 Nd 144.27	61 Il 146 (?)	62 Sm 150.43	63 Eu 152.0	64 Gd 156.9	65 Tb 159.2	66 Dy 162.46	67 Ho 163.5	68 Er 167.2	69 Tm 169.4	70 Yb 173.04	71 Lu 174.99

The numbers in front of the chemical symbols represent the atomic numbers; those following, the atomic weights. The geometric figures indicate the crystal structure at room temperature.

□=Face-centered cubic ⊡=Body-centered cubic ⬡=Hexagon ⬭=Rhombohedral ⊡=Body-centered tetragonal ◫=Diamond lattice α,β=Modification

□*=Complex cubic ⊙=One-face centered orthorhombic ⬭=Face centered orthorhombic ▱=Monoclinic

cause of this situation I have chosen to discuss briefly some of the more fundamental phases of metallurgy in an attempt to show the trend in scientific metallurgy rather than burden you with practical details with which you are already familiar.

✦ ✦ ✦

The Metallic State

METALS are so widely and generally familiar that little thought is given to any consideration of their nature or properties. In fact, metals are the corner stone of modern civilization. The extent of this dependence of civilization on metals is evidenced by their extensive use, i.e., from the minutest household article such as the common pin to the most powerful turbine and airplane. Some of the achievements that brought victory could not have been accomplished without metals, i.e., radio communication, radar, powerful and portable lighting equipment, armor and armor-piercing projectiles, transportation facilities for both land and water travel, building construction of all kinds, and finally and triumphantly, the atomic bomb.

✦ ✦ ✦

THE most significantly outstanding properties that metals possess and which make them desirable for their mechanical and constructional applications are their outstanding combination of strength and plasticity. In addition, they are excellent conductors of heat and electricity and are in varying degrees resistant to corrosion. The question now logically raises itself as to the origin of the various metallic properties.

✦ ✦ ✦

IN general, it can be stated that two questions must be answered to explain the metallic state: (1) the metallic atoms themselves and (2) the arrangement or grouping of the metallic atoms in the so-called metallic state.

✦ ✦ ✦

CHEMISTS and physicists quite early learned that all of the elements could be systematically arranged and classified in such a manner that certain groups could be separated according to general group properties. This arrangement of elements is known as the Periodic Table and is shown in Figure I. In the most usual form of presentation the first column contains the elements (metals), lithium, sodium, potassium, copper, rubidium, silver, cesium and gold. However, the separation of the elements (metals), copper, silver and gold into 1B group and the remaining metals (alkali metals) into a 1A group would result in two sub-groups, each having metals of quite similar properties. This separation has therefore been made in each of the eight groups as is shown in Figure I. By adopting this regrouping into A and B divisions, the metals fall into four or five natural families with close resemblances among the members. Therefore, such group designations as the "light metals," "ductile, high melting heavy metals," "low melting heavy metals," etc. will be found to designate groups of metals that resemble each other in such important properties as strength, density, affinity for oxygen, etc.

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IT is perhaps unusual and novel to come before a group of practical men with so theoretical and academic a presentation as the Periodic Table and the question is therefore rightfully put as to the value and application of such a consideration. The classification of the metals into groups is extremely valuable since it enables one to anticipate and in some instances predict with considerable certainty the properties of a metal with which one has had little experience and is therefore not familiar, and this soley by knowing to what family it belongs. For example, beryllium would be expected to have properties similar to its neighbor magnesium. In fact, this is not a mere supposition but is actually the truth of the matter. It is significant to note that although resemblances within each family are marked, nevertheless the individual differences between the metals are also pronounced. Thus, if zinc plating is not suitable as protective coating for a specific corrosion problem, it is then logical to try another metal near it in the Table, such as cadmium. Therefore by becoming familiar with the attributes and properties of one or two members of a family it is possible to predict with considerable accuracy the properties of any other member of that family. These are just a few of the applications of the periodic classification of the elements.

✦ ✦ ✦

The Atom as a Physical Entity

THE reaction of metals to their environment is in the ultimate analysis the reaction of individual or groups of atoms to externally applied physical factors. Therefore, it is important to know something about the architecture of the atom if the behavior of the metals is to be interpreted intelligently.

✦ ✦ ✦

THE physicists have given us a picture of the atom which depicts it as being an orderly aggregate of electrons, protons and neutrons. These in effect are the building blocks not only of individual atoms but of all matter in general. The protons constitute the positive charge of the atom and together with the neutrons are concentrated in the center or nucleus of the atom, and constitute the greater part of the atom's weight. The electrons are negatively charged and balance the protons in charge. They are most simply represented as being arranged around the nucleus in concentric shells. When there are a definite number of electrons in the shells, they are stable and therefore do not have a tendency to either take on or give up electrons. Now, proceeding outward from the nucleus we find that the electron configuration per stable shell varies, as is presented in the Periodic Table, namely, 2, 8, 8, 18, 18, 32 and 6. For a given element the number of electrons that are associated with the nucleus is equal to the atomic number. Since the algebraic sum of the positive and negative electrification of an atom must be zero, it follows that the excess positive charges resident upon the nucleus must be equal to the number of electrons outside the nucleus. This number which has come to be recognized as more important and characteristic than the atomic weight, is known as the atomic number. The atomic numbers apparently determine all the properties

of each element and are more fundamental than the atomic weights.

✦ ✦ ✦

SODIUM (Figure 2.) has an atomic number of 11 and the 11 electrons are associated with the nucleus in shells of 2, 8 and 1. The outer single electron is known as the valence electron. The number of valence electrons will vary from one metal or element to another. In the metallic state several atoms may share valence electrons in order to make up the stability of the metallic crystal. Also the valence electrons in the unfilled outer shell are free to migrate under external excitation. This fact largely accounts for metallic properties.

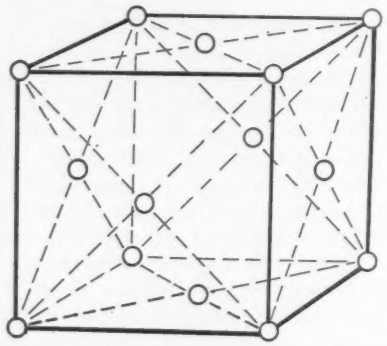


Fig. 3 The Face Centered Cubic Arrangement of Atoms. Examples of Metals Crystallizing in This System are Copper, Lead, Platinum and Gamma Iron. ✦ ✦ ✦ ✦

IT must also be understood that the electrons in the atom are in constant motion around the nucleus and are also spinning on their own axis, similarly to a miniature solar system.

✦ ✦ ✦

NOW that the nature of the atom has been very briefly presented it would be well to examine how the atoms arrange themselves in a metal crystal. To know something about the arrangement of atoms is important for as we shall see this atomic arrangement accounts for many of the physical properties of metals.

✦ ✦ ✦

BEFORE briefly discussing the fundamental crystalline properties it should be pointed out that the external form of a material is not in any way correlated with the ultimate nature of crystallinity. Crystallinity lies in an orderly and repeating ar-

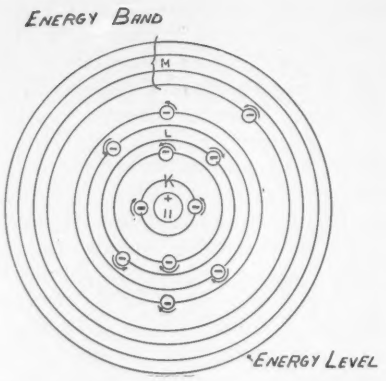


Fig. 2. Schematic Representation of The Sodium (Na) Atom. ✦ ✦ ✦ ✦

rangement of atoms. The atoms arrange themselves in definite geometric patterns. Most of the metals crystallize in fairly simple arrangements—the cubic, the hexagonal and the tetragonal system.

✦ ✦ ✦

THE pure metals generally crystallize in one of three crystal systems just enumerated. Nickel, copper, aluminum, silver and gold have a face centered cubic crystal structure (Figure 3.). All of these metals have good ductility even at extremely low temperatures as is shown in the following table. Only the very high melting members of the face centered cubic group, i.e., iridium and rhodium, become somewhat brittle at the temperature ranges at which the other metals are worked. Tin, which crystalizes in the body centered tetragonal lattice is the only other well known metal that has the ductility that is characteristic of the

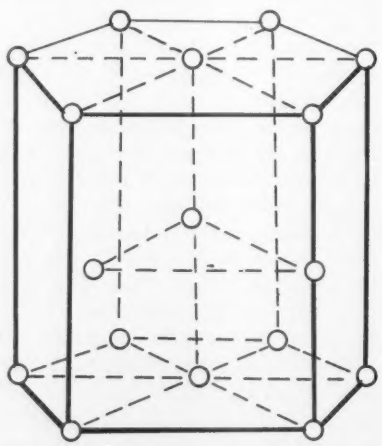


Fig. 5. The Hexagonal Close Packed System. Examples are Zinc, Cadmium and Manganese.

face centered cubic type. The body centered cubic metals, Figure 4, i.e., iron, tungsten and molybdenum, are difficult to work under certain conditions primarily because of their brittleness at room temperature. The same is true of the hexagonal close packed metals, Figure 5, zinc, cadmium and magnesium, even in view of their comparatively low melting points.

✦ ✦ ✦

BECAUSE of this orderly arrangement of atoms it is possible to designate directions in crystals according to a systematic means of numbering Figure 6. These directions are called planes and are described by referring them to the coordinate axes of three-dimensional space. Therefore, faces of a crystal or planes in a crystal are really sheets of atoms regularly and definitely spaced according to a repeating pattern. Because of the geometric arrangement of atoms in a crystal one is not greatly surprised to find that the properties vary in different directions. For example, the modulus of elasticity and ferro-magnetism are properties that vary with direction in the crystal in which they are measured as well as the electrical conductivity.

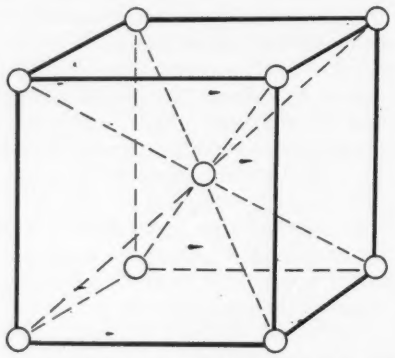


Fig. 4. The Body Centered Cubic Arrangement of Atoms. Some Metals Occuring in This System are Tungsten, Molybdenum, Manganese, Sodium, Potassium and Alpha Iron. ✦ ✦ ✦

✦ ✦ ✦

IF a sufficient force is applied to either a single crystal or an aggregate composed of many crystals (poly-crystalline aggregate), the shape of the object will be altered. Such change in shape is accompanied by phenomena within the crystal which are quite fundamental.

To discuss the changes accompanying deformation in detail is beyond the scope of this discussion; however, they will be briefly summarized. The deformation of metals takes place by slipping, bending and rotation of the various planes in the crystal or by twinning of crystal fragments or in some instances by a combination of all four processes. Generally slip (or gliding) along crystallographic planes occurs most readily parallel to those planes that have the greatest atomic population and in the direction of the densest atomic population. It is quite likely that the high formability of the face centered cubic metals is related to the fact that they possess a large number of planes of dense atomic population and therefore also have large numbers of planes and directions of easy slip. As slipping continues, resistance to further deformation or slip increases until finally the stress increases far enough to produce slip on another plane. During the process of deformation, bending of the slip planes occurs. There is also crystal fragmentation and rotation of the fragments to bring the slip planes and slip directions more nearly parallel to the direction of stress.

✦ ✦ ✦

WHILE the fundamental laws of slip have been developed essentially from work on single crystals, it can be readily seen that deformation in polycrystalline aggregates must follow the same pattern. However, because of the larger number of grains many more slip systems and groups of slip planes must operate. In cubic metals this is easy to achieve because there are actually many slip systems possible, but in hexagonal metals this is not the case and they therefore possess a much lower capacity for deformation. As the number of grains in a given volume of metal increases (reduction in grain size), there is a corresponding improvement in physical properties, i.e., the metal becomes harder and stronger and more resistant to shock on suddenly applied loads.

✦ ✦ ✦

DEFORMATION markedly alters many of the physical properties, notably increasing the tensile strength, yield strength and hardness. The modulus of elasticity is variously affected, increases up to 20% having been noted. The specific electrical resistance is increased and the magnetic properties are modified. For example, the permeability, remanent magnetism, susceptibility and saturation magnetization are decreased, while the coercive force and the hysteresis losses are increased.

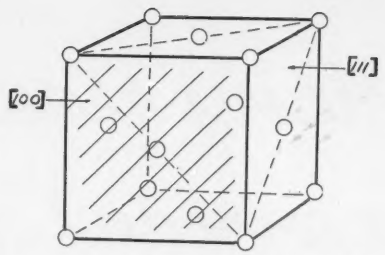


Fig. 6 Schematic Representation of the Slip Plane in a Face Centered Cubic Lattice. The (111) Plane is the Plane of Densest Atomic Population and is the Plane Along Which Slip Occurs. ✦ ✦

✦ ✦ ✦

DEFORMATION also alters several other properties which are not generally considered but which are of tremendous practical importance, namely, the electrochemical potential and the free energy. Changes in electro-potential are of practical importance because the e.m.f. set up in a non-uniformly deformed piece of metal can initiate serious and rapid electrolytic corrosion at the deformed area in the presence of an electrolyte such as salt water or water containing an electrolyte in general.

✦ ✦ ✦

Zonal Structure in Drawn Wires

Clark describes an X-ray analysis of drawn copper wires which is of interest in connection with the problem of preferred orientation resulting from cold working by wire drawing. It was found that the extreme outer layers the crystals had a nearly random orientation. Fibering was not found as anticipated. When the wire was etched down in successive steps and X-Ray examinations made, it was found that the core showed extreme fibering. Therefore, wires drawn through dies have distinctly zonal structures with the grains becoming more perfectly

EFFECT OF TEMPERATURE ON THE PHYSICAL PROPERTIES OF METALS

A—Hardness

Metal	Brinell Hardness Atmospheric Temperature	Brinell Hardness Liquid Air —300°F.
Pure Iron	80	269
Steel (C. O. 80%)	230	330
Pure Nickel	98	120
Pure Copper	51	66
Aluminum	24	53
Duralumin	101	129

B—Impact Strength (Toughness)

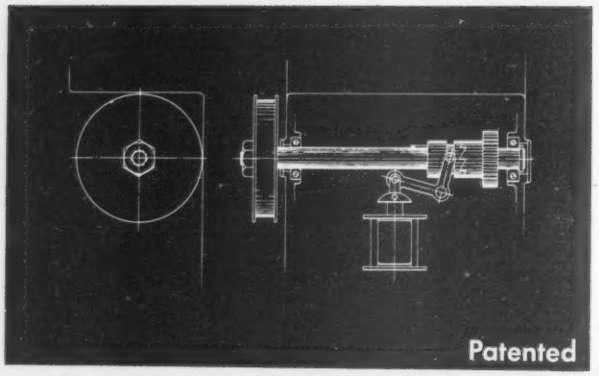
	Guillery Impact 70°F.	Guillery Impact Liquid Air —300°F.
Pure Iron	21.2	1.9
Copper	20.6	20.1
98.8% Nickel	47.5	40.6

C—Tensile Strength — Pounds/Square Inch

Metal	Room Temperature Tensile Strength	Room Temperature Elongation	Liquid Air (—300°F.) Tensile Strength	Liquid Air (—300°F.) Elongation
Copper	32,600	68.0	50,400	63.0
Duralumin	57,800	32.7	71,800	28.0
Nickel	93,400	32.7	122,500	46.7
Steel (C. O. 40%)	79,400	30.8	139,400	7.3
(1) Nickel-Iron Alloy	120,500	20.4	160,000	14.1

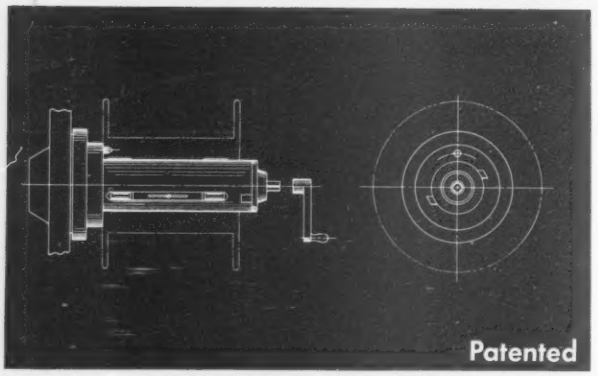
(1) Nickel 24.6%; Carbon 0.56%; Manganese 1.18%. Alloy had 67.4% R.A. at Room Temp. and 64.0% at temperature of test which in this case was —112°F. Copper under same conditions of test had 70.0% R.A. at Room Temperature and 67.7% R.A. at —112°F.

6 of the many reasons why progressive wire and cable mills are...



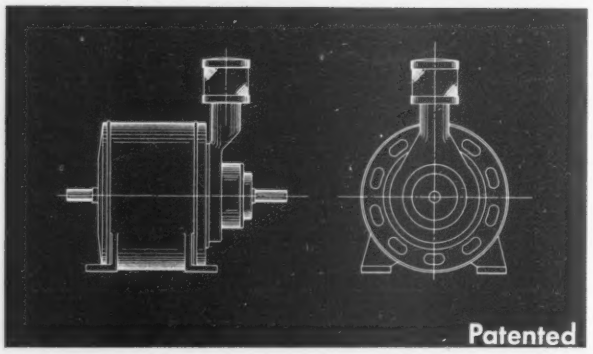
FREE WHEELING CAPSTAN CONTROL

An exclusive Syncro design . . . prevents wire breakage and "burning off" of wire during deceleration . . . eliminates slip on the finishing capstan during deceleration . . . reduces wear.



EXPANDING ARBOR

An exclusive Syncro design . . . speeds up reel changes . . . permits use of reels with out-of-round or over-size cores . . . greatly increases safety of reel changing operation . . . reduces spooler vibration.



MAGNETIC SLIP CLUTCH

An exclusive Syncro design : . . provides constant wire or cable tension from empty to full reel . . . permits adjustment of wire tension while spooling . . . provides "stand-by" wire tension . . . insures smooth shockless starting.

SYNCRO MACHINE

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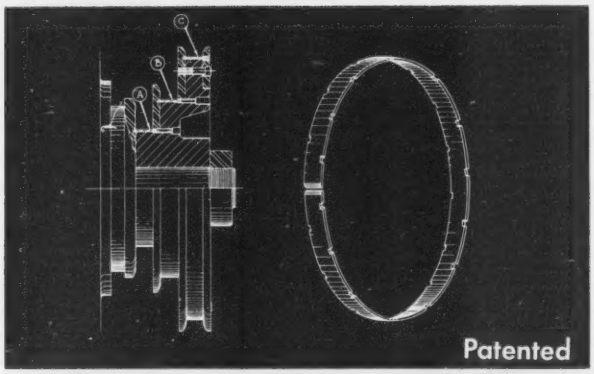
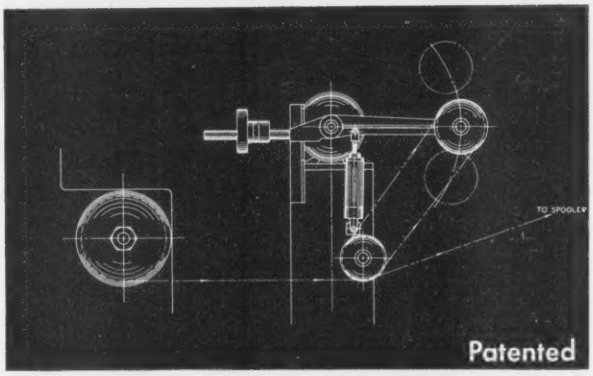
An exclusive feature of Syncro wire drawing machines . . . provides a smooth, clean, tough working surface on drawing blocks . . . maintains minimum-slip condition . . . easily replaceable when necessary.



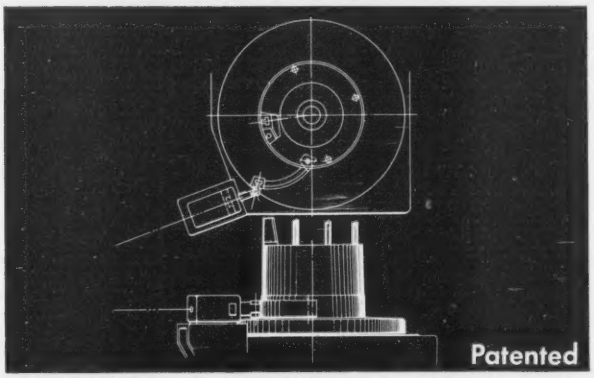
ADJUSTABLE WIRE TENSION CONTROL

An exclusive Syncro design . . . controls magnetic slip clutch output . . . maintains any selected wire tension throughout the filling of a reel . . . permits spooling of the wire on large reels . . . easily adjustable . . . positive control.



AUTOMATIC PULL-IN STARTING CLAMP

An exclusive Syncro design for rodblocks . . . reduces time and labor in stringing . . . eliminates scoring of drawing block surface . . . recommended especially for drawing of high tensile materials . . . accessible, efficient and safe.



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orientated, the nearer to the wire axis considered as a line at the exact center.

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STATED differently, on being drawn through the die, the flow of metal in exactly the direction of drawing occurred only in the middle of the wire, whereas in the walls, the metal is flowing inward as well as along the length of the wire and the grains are therefore arranged at an angle to the core. The texture of a hard drawn wire may therefore be represented as shown in Figure 7.

✦ ✦ ✦

Schmid and **Wasserman** report tests of tensile strength in kilograms per square millimeter corresponding to zones for two specimens of copper wire as follows:

Sample Number 1		Tensile Strength
Original Diameter	4.85 mm.	38.3
Etched to	3.20 mm.	41.3
Drawn to	3.20 mm.	45.2
Sample Number 2		
Original Diameter	1.75 mm.	46.1
Etched to	1.00 mm.	52.8
Drawn to	1.00 mm.	51.0

✦ ✦ ✦

IT becomes apparent that the core or central zone has the highest tensile strength which is in keeping with its parallel preferred orientation. It should also be pointed out that improvement of the physical properties in the superficial zones is not achieved by increasing the amount of cold work.

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The Cause of Work Hardening

THE plastic deformation of metals leads to a decided increase in hardness which is of significant practical value and has therefore received considerable attention. Several theories have been advanced to account for the increase of hardness with cold working and are presented herewith.

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HOWEVER, before presenting the various theories of work hardening it would be well to review some facts that have been established by means of X-ray analysis. First, with the onset of deformation there is a breaking up or fragmentation of the crystal lattice. The fragments produced are of the order of 10,000 atom diameters. The fact that fragmentation occurs is in itself not surprising. However, the outstanding observation is that the fragments do not become smaller with progressive amounts of deformation but reach the size of 10,000 atom diameters in the earlier stages of deformation and show no further break-up.

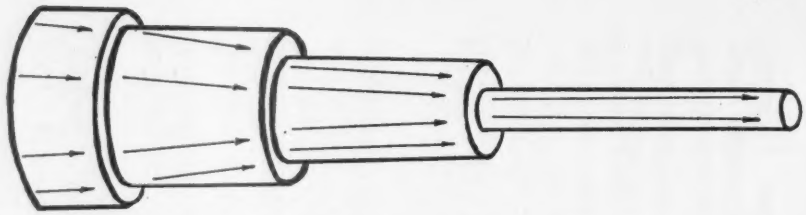

Fig. 7. Schematic Representation of Zonal Structure in Hard Drawn Wire. ✦ ✦ ✦

✦ ✦ ✦

SECOND, as deformation or slip proceeds, the slip planes swing or rotate into the plane of the applied stress and a preferred orientation develops.

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THIRD, the crystallographic dimentions of the metal are substantially unchanged, regardless of the extent of the deformation. Any lattice distortion that occurs is within the elastic range and soon reaches a maximum value. Lattice distortion in the elastic range indicates a bending of the planes and an increase in internal energy. Such bending or roughening of slip could possibly increase the frictional resistance to movement or slip along that plane. However, there are metals such as aluminum, molybdenum and platinum which show decided work hardening yet develop practically no lattice distortion.

✦ ✦ ✦

COMING now to the grain fragmentation or crystal shattering mentioned previously, it would appear that here would be an explanation of work hardening. For example, if it is assumed that the crystal fragments would have their slip planes in disregistry or slightly out-of-line, such discontinuity would restrain or at least restrict slip. This conception would offer an explanation were it not possible to remove the effects of work hardening by heating without removing the crystal fragmentation.

ANOTHER of the effects of work hardening is the development of a preferred orientation. Microscopic examination of drawn wire clearly shows the normally equiaxed grains elongated into a fibre structure. Such lining up of planes or groups of atoms must contribute in a measure to the phenomena of work hardening but it is unlikely that it is a fundamental cause of work hardening. One thing is known though, namely, that directional properties are associated with the appearance of preferred orientation. Perhaps the most significant reason for believing that the appearance of a preferred orientation of crystal planes is not a fundamental factor in determining work hardening is the observation that a preferred orientation does not develop until 30-50 per cent of deformation has occurred. Work hardening, however, begins to appear immediately with the onset of deformation. Thus, preferred orientation while being a characteristic of cold work is not primary cause but an associated condition.

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THE occurrence of directional properties resulting from a preferred orientation are of considerable practical importance since, it is desirable to have uniform properties in all directions. For example, the mechanical properties of zinc are highly directional and depend upon the nature of the preferred orientation. All properties of non-cubic metals, as for example — zinc, show appreciable variation in different directions even when fine grained. It should be pointed out that industrial annealing operations generally remove a preferred orientation in most metals and alloys. However, in some instances the combination of severe reductions and high annealing temperatures results in a more perfected preferred orientation than can be developed by

any working process. Some of the face centered cubic metals such as copper, gold and nickel develop comparatively simple types of preferred orientations in the annealed sheet, (i.e., cube edges nearly parallel to the rolling and the transverse directions of the sheet).

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WHILE preferred orientation is generally not a desirable condition from an engineering or constructional viewpoint, it so happens that occasionally this condition may even be highly desirable. For example, the preferred orientation in iron-silicon sheet may be such that highly desirable magnetic properties are accentuated in the direction of rolling, (i.e., high permeability and low core loss). This is the case if the cubic axis (100) is oriented parallel to the rolling direction and the dodecahedral (110) direction, which has a lower permeability, coincides with the transverse direction.

✦ ✦ ✦

OF the more recent theories that offer considerable possibilities in explaining work hardening are those set forth by **Taylor, Polanyi** and **Orowan.** They are based on the premise that the strength of the crystal is fundamentally that which can be calculated from the physical contants of the crystal lattice, and not that which is determined from experimental determinations. In these theories it is postulated that the observed strengths are derived from the planes of weakness in the crystal. As the initial stress is applied the weakest planes are the first to slip and as these work harden, the deformation is transferred to progressively stronger planes, thereby necessitating the application of progressively higher stresses. This type of analysis eliminates the need for explaining work hardening on planes that are not participating in the process of slip. The factors that determine on which of the planes localized slip occurs are said to be the degree of perfection of the slip planes and their orientation with respect to the applied stress. As the process of slipping continues, mutual interference of localized slip areas and elastic distortion serve to stop slip, and some other plane in the crystal which was originally comparatively stronger, begins to slip. The degree of perfection determines the relative weakness of each plane. The limiting strength for any plane is the theoretical strength of the particular lattice involved. While several theories have been presented to account for so common and important a phenomena as work hardening, it is evident that none so far is comprehensive enough to explain the changes in properties that are instituted by plastic deformation.

✦ ✦ ✦

The Effect of Alloying on Metallic Properties

THE foregoing has shown that the application of mechanical forces alone can very decidedly affect the physical properties of metals. For example, the high permeability of "Permalloy" is to a great extent destroyed by even a very slight deformation. Another means of modifying the properties of a pure metal to make it suitable for specific applications is in the intentional addition of one or more other metals. Small amounts of impurities can also extensively modify the physical properties of the pure metals.

✦ ✦ ✦

THE influence of small amounts of other elements is clearly shown by the behavior of copper. Oxygen free copper (OFHC) differs from ordinary tough pitch copper by lacking only a small amount of oxygen, 0.03-0.06%, yet it has remarkable toughness on twisting in even the cold worked condition. In addition, it can be heated in reducing atmospheres (hydrogen) without becoming brittle like tough pitch copper. As little as 0.002 per cent bismuth forms a brittle network around the copper grains and over 0.05 per cent of the copper cannot be cold rolled.

✦ ✦ ✦

SMALL quantities of added metals can also bring about desirable properties, for example, additions of lead up to 1 per cent to zinc greatly improve the forming properties if the temperature is below 400° F. Cadmium if present in quantities over 0.5 per cent and iron over 0.01 per cent have a very deleterious effect on both the forming properties and the corrosion resistance as are needed in certain applications as impact extruded battery cells.

✦ ✦ ✦

GOLD containing as little as 0.005 per cent lead is unworkable due to the formation of eutectic structure at the grain boundaries. Nickel becomes brittle if as little as 0.01 per cent of elemental sulphur is present and monel metal is similarly affected by 0.02 per cent sulphur.

✦ ✦ ✦

SMALL quantities of impurities have a pronounced effect on other properties such as the recrystallization temperature. For example, 0.087 per cent of silver raises the recrystallization temperature from 200° to 350° C. (**Bassett & Davis**).

✦ ✦ ✦

IN the manufacture of lead cable sheath small additions of other metals confer desirable properties. Such alloys have a higher fatigue strength then pure lead and considerably higher mechanical properties. Fatigue strength is especially important where the cables are suspended, i.e., overhead telephone cables. The three most frequently used alloys for lead sheathed cable are, 0.75 per cent antimony, 1 to 3 per cent of tin, and lead with about 0.06 per cent of copper. In England an alloy is used for leaded cables which contains 0.25 per cent cadimum, and either 0.5 per cent of antimony or 1.5 per cent of tin, and is claimed to develop even higher properties than the alloys just mentioned. Lead alloys with 0.05 to 0.08 per cent tellurium or 0.03 to 0.05 per cent calcium retain work hardening and the fibrous structure at room temperature, whereas pure lead recrystallizes at room temperature. Lead alloys of copper and calcium have superior creep resistance to pure lead. This is of special significance in the manufacture of oil filled power cables, where the continuous application of low hydrostatic pressures leads to plastic flow and eventual failure by rupture. In this respect tin and antimony do not benefit pure lead to a significant degree. However, any addition to lead improves the fatigue strength from 50 to 200 per cent, depending on the particular metal added, i.e., copper or calcium.

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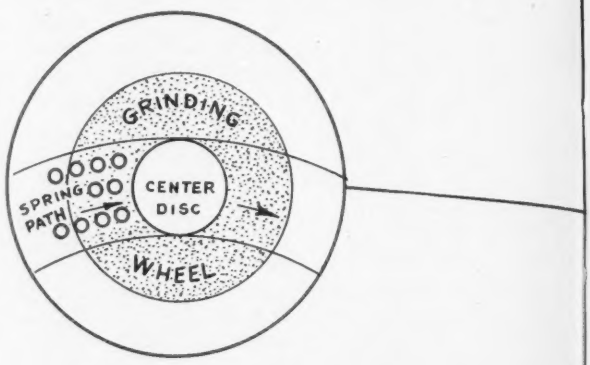
MULTIPLE PASS GRINDING, practical only with the revolutionary new Torrington Spring Grinder, enables springmakers to grind springs to tolerances formerly unheard of, and accomplish the feat at production speeds in excess of those possible with any other facilities.

This new, patented grinder gently removes a few thousandths from both ends of the springs simultaneously, at each revolution. When the desired dimension is reached, it "sparks out" to a precision finish. Multiple pass grinding produces no burning, no burring, no deformation of the spring. The ground surfaces are at true right angles to the axis of the spring.

ONE pass grinding is also available on the Torrington Spring Grinder, by use of the lower speed range of the work carrier wheel. Use of the two ranges may be combined, using rapid traverse of the unused portion of the wheel for small, single pass runs. Production under the single pass method is equivalent to, or higher than is possible with any other machine.



Uniform grind on every spring. Arcuate spring path across center of grinding wheel not only results in same treatment for every spring, but causes wheel to wear evenly—prevents coning. Center disc of softer abrasive to compensate for slower surface speed. No abrasive is wasted; wheel dressing is practically eliminated.

SPECIFICATIONS

Spring Capacity: Lengths ⅝" to 16"; diameters ¼" to 7"; wire diameters .040" to .375".
Grinding Wheels: Diameter 24"; maximum usable abrasive 2½".
Grinding Feed: .010" to .100" per minute.
Work Carrier Wheel Speeds: 4 to 16 revolutions per hour, or 1.1 to 4.5 revolutions per minute.
Available Work Carrying Area: (including spring holders) approximately 850 sq. in.
Work Carrier Wheel Diameter: 54"; width of grinding path 8½".
Floor Space Required: 54" x 100"; maximum overall height 116".
Weight: 14,000 lbs.

SPECIAL FEATURES

LOAD INDICATOR shows electrical load on each grinding wheel motor. Any excess load is instantly visible.

TILTING MECHANISM permits quick manual changeover of grinding wheels, in or out of parallel as desired for single or multiple-pass grinding. Degree of tilt shown by pointer and scale.

GRINDING WHEEL MOVEMENT manually or by motor, either wheel independently or both in unison, except that lower wheel remains stationary when grinding.

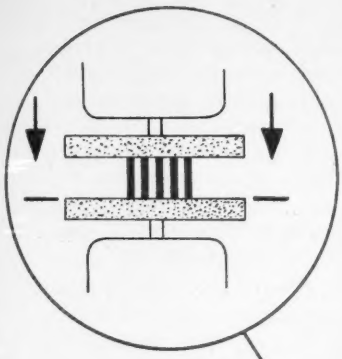
DUST EXHAUST through customer's system, or dust collector unit may be furnished. Either attaches to built-in duct from grinding wheels to exterior of grinder.

OBSERVATION WINDOW, glass covered, with steel protector slide, for ready inspection of grinding action.

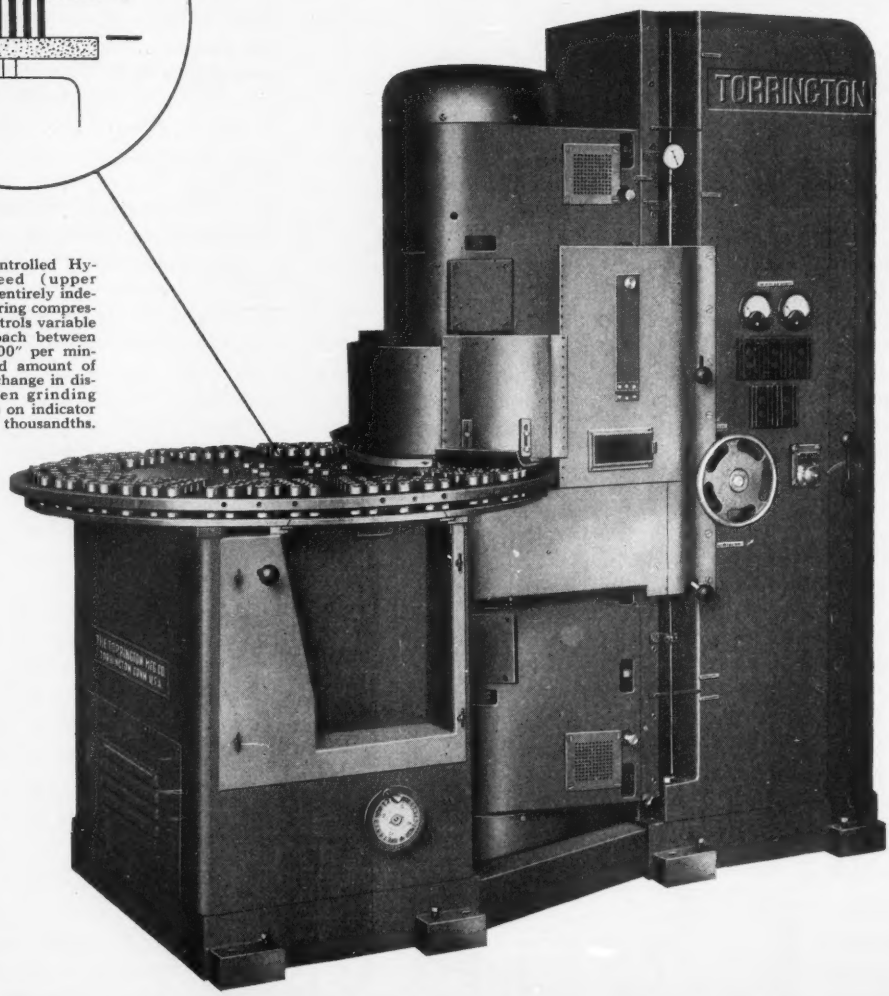
STEEL WEAR PLATE on work carrier wheel table is abrasive resistant, but is also easily replaceable.

GRINDING WHEELS easily removable, by dismounting wheel plates.

nGTon



Positively controlled Hydraulic Infeed (upper wheel only), entirely independent of spring compression. Dial controls variable rate of approach between .010" and .100" per minute. Rate and amount of feed, or any change in distance between grinding wheels visible on indicator graduated in thousandths.



Patent No.
2,375,333

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Types of Alloying

WHEN metals are alloyed, the stranger atoms (or added atoms) may distribute themselves in the parent metal lattice according to several arrangements.

1. **Simple substitution or replacement of parent atoms by the stranger atoms. (Substitutional solid solutions).**
   Note
   A solid solution is a phase which contains two or more different kinds of atoms in one type of crystal lattice, and in which the various kinds of atoms are not combined in a definite proportion.
2. **Intermediate constituents.**
3. **Interstitial solid solutions, where the stranger atoms fit into the spaces between the parent atoms.**

✦ ✦ ✦

Substitutional Solid Solutions

IN the crystals of pure metals each point on the space lattice is occupied by the same kind of atom. In the substitutional type of solid solution some of the parent atoms are replaced by the "dissolved" or stranger atoms. Most of the solid solutions encountered in practice are of this type. Generally the different kinds of atoms in a solid solution are distributed according to the laws of statistics or at random in the positions of the same lattice. Where there is only a limited solid solubility of one metal in another the resulting alloy has the same crystal lattice as the parent metal. However, the dimensions or lattice parameter of the pure (parent) metal is either expanded or contracted depending **upon the size and quantity of stranger atoms present.**

✦ ✦ ✦

Interstitial Solid Solutions

IN the interstitial type of solid solution the stranger atoms occupy the vacant spaces between the parent metal atoms. Carbon, boron, nitrogen and hydrogen, which have a small atomic size, very frequently dissolve in solid metals to give this type solid solution. Austenite, the gamma solid solution of carbon in iron, is of the interstitial type and forms the basis for steels.

Requisites for Solid Solution Formation

IN two component alloy systems complete solid solubility may occur if the following requisites are met:

1. **The two metals have the same crystal structure.**
2. **Similar properties, such as melting point, chemical affinity, etc.**
3. **If the kinds of atoms involved do not differ in size by more than 15 per cent. If the difference is greater than 15 per cent, limited solid solubility results.**

✦ ✦ ✦

FOR example, copper and nickel form a continuous series of solid solutions; their lattice parameters differing only by about 1.8 per cent. The same is true of the silver-gold system where the lattice parameters differ by only 0.1 per cent. To further illustrate this relationship take the copper-silver system where the component metals have similar properties but the difference in atomic size is approximately 15 per cent. Gold and aluminum have nearly the same atomic diameters but do not form either a continuous or an extensive series of solid solutions because they vary widely in chemical properties. They do, however, form many intermediate phases.

✦ ✦ ✦

THUS far we considered alloying and solid solutions from more of a mechanical than an electronic viewpoint. Many of the properties and attributes of alloys can be better understood if the part that electrons play is considered. However, a consideration of intermediate phases is most readily accomplished by taking into account the influence of electrons.

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Intermediate Phases

INTERMEDIATE phases were formerly believed to be chemical compounds and were designated by definite chemical formula. More thorough investigation has, however, shown that many of these aggregates could not be represented by any simple formula and that in addition they are likely to be very complex crystallographically. However, it has been found that the structure of an intermediate phase is frequently determined by the ratio of the number of valence electrons to the total number of atoms in the formula, or the valence-electron concentration. It has also been demonstrated that intermediate phases which have the same type of lattice structure frequently have the same ratio of the number of electrons to atoms. For example, the phases AgCd and Cu_3Al both have body centered cubic structures B (Beta) and the ratio of valence electrons to the total number of atoms is 3:2. This value is arrived at as follows: two atoms are involved, one of silver and one of cadmium (AgCd); silver (Ag) has a valence of 1 (one valence electron per atom); cadmium (Cd), a valence of 2; adding 1+2=3, and since two atoms are involved we have the ratio 3:2.

✦ ✦ ✦

INTERMEDIATE phases in which the ratio is 7:2 generally have an hexagonal close packed lattice.

✦ ✦ ✦

THE stable intermediate phases (or compounds) of an alloy system correspond to definite composition, i.e., CuZn, $CuAl_2$, etc. Such constituents are always harder than the metals that constitute them. In general they are hard to the extent that they are brittle and have very little capacity for deformation. Such brittleness, (high hardness and lack of metallic properties),

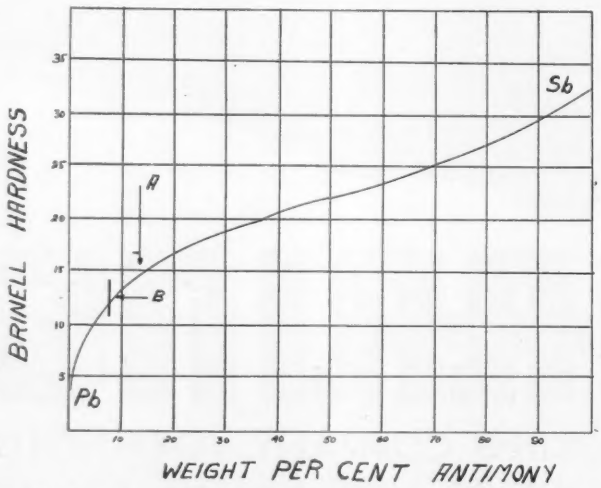

Fig. 8. Hardness of Lead-Antimony Alloys. Point "B" is the Limit of Solid Solubility and "A" the Eutectic Composition. ✦ ✦

is probably due to the formation of homopolar bonds especially when one constituent is a non-metal such as in Fe_3C and Fe_4N. This class of compound is generally high melting and retains its hardness to quite a high temperature.

✦ ✦ ✦

MANY very useful industrial alloys depend upon the presence of intermediate compounds, i.e., Fe_3C (iron carbide) in steel and $CuAl_2$ in aluminum to form the heat treatable aluminum alloys. Both of these compounds have a common effect in that a small amount will stiffen an otherwise soft metal.

✦ ✦ ✦

EXAMPLES of high melting point and hard compounds are the carbides of tungsten and tantalum which form the basis of a number of useful industrial alloy compositions, such as high speed steels, the sintered carbides for dies and cutting tools, etc.

✦ ✦ ✦

THE compounds of iron and nitrogen Fe_4N are formed in nitriding and are responsible for the formation of the extremely hard surface of nitrided steel.

✦ ✦ ✦

THE phosphide of copper is an essential component of very fluid soldering and brazing alloys that are to a great extent self-fluxing.

✦ ✦ ✦

Properties of Alloys and Solid Solutions

IT is apparent that the structures found in alloys can vary considerably and therefore it is not surprising that their properties may also vary, sometimes in an unexpected manner. However, certain general relationships can be drawn which are generally applicable.

✦ ✦ ✦

Hardness—Simple Eutectic Series

FOR any alloy series in which the two metals are practically insoluble in each other in the cold state, i.e., a simple eutectic series of which the lead-antimony system is an example, the hardness follows an approximately linear relationship between the hardness of pure lead and that of pure antimony. It varies with the relative proportions of the two kinds of crystals present. Although two phases or constituents are dispersed, it must be remembered that in the ultimate analysis strength and hardness will depend upon their form and degree of distribution. For example, if as in the age hardening alloys one constituent is in a highly dispersed form its effect will be greater than expected and will not vary linearly. Figure 8 shows the hardness of lead-antimony alloys.

✦ ✦ ✦

Solid Solutions

IN those cases where metals form solid solutions the hardness of either of the pure metals involved is increased by the introduction of stranger atoms into the crystal lattice. The hardness increases continuously until the two kinds of atoms are present in an equal amount, i.e., 50 atomic per cent. This is shown for the copper-nickel alloys in Figure 9.

✦ ✦ ✦

THE copper-nickel alloys demonstrate an effect common to solid solutions generally, namely, that the addition of a softer metal (copper) to a harder metal (nickel) increases the hardness of the already harder nickel. The problem resolves itself not so much into the relative hardnesses of copper and nickel as it does into the effect of introducing stranger atoms into crystal lattice of the parent metal and of the lattice forces that are thereby brought into play because of the interaction of two kinds of atoms.

✦ ✦ ✦

THE present state of knowledge concerning the metallic state is not sufficiently advanced to predict quantitatively the effect of lattice distortion and of the new or at least modified electron distribution around the atomic nucleus upon lattice energetics. It could be expected though that at 50 atomic per cent the lattice distortion would reach a maximum and that the resulting distortion of lattice forces and the more or less disrupted continuity of the slip planes would have a slip restraining effect. In alloy systems with a limited miscibility the extent of the solid solubility is determined by the capacity of the solvent (parent) lattice to undergo distortion in accommodating the stranger (solute) atoms. Under such conditions the limit of solid solubility corresponds to the maximum distortion that the lattice can accommodate itself to. Therefore in those alloy systems where the maximum solid solubility is small the lattice distortion should be pronounced and the increase in hardness should also be great even in low concentrations.

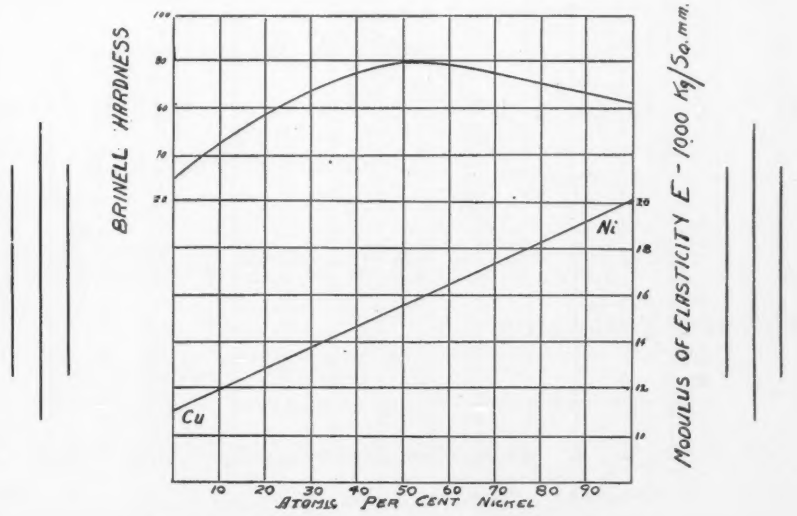

Fig. 9. Hardness and Modulus of Elasticity of Copper-Nickel Alloys.

THE investigations of **Ludwig** seem to support such a theory as is shown in the following table:

HARDNESS OF LEAD ALLOYS

Added Metal	Average Increase in Hardness for 1 Per Cent	Solution Becomes Saturated At
Bismuth	0.5	30.0
Tin	1.8	10.0
Cadmium	4.8	5.5
Antimony	10.1	2.5
Magnesium	11.0	0 (?)

✦ ✦ ✦

COMPARISON of the copper-zinc alloys with copper-cadmium shows a similar effect, 1.5 per cent of cadmium is decidedly more effective hardening copper than 1.5 per cent zinc.

✦ ✦ ✦

Electrical Conductivity

Duplex Alloys

IN alloy systems that develop a duplex structure and whose components are insoluble in each other, the conductivity will be almost proportional to the **volume** of each type of crystal in the alloy and to the specific conductance of each type. Calculated values deviate somewhat from observed values, probably because the ultimate arrangement of the particles plays an important role in determining the conductivity. Figure 10 shows the conductivities of a group of cadmium alloys.

✦ ✦ ✦

Solid Solutions

THE conductivity of pure metals drops decidedly even on the addition of minute traces of added metals, i.e., when a second element is dissolved in the crystal lattice of the parent metal. The electrical conductivity of the gold-silver alloys is shown in Figure 11. The conductivity curve here takes the form of a deep U. The outstanding observation is that the addition of even a small amount of silver which has an excellent electrical conductivity causes a remarkable decrease in the conductivity of gold. The same holds true in copper-gold system where in spite of the higher conductivity of copper a decided drop is noted in the conductivity of gold. This increase in resistance may be attributed to various factors which restrict or interfere with transfer of valence electrons through the lattice.

✦ ✦ ✦

A CONCEPT of electrical conductivity is based on the postulate that the electrons are free to move throughout the lattice in definite energy levels while holding the positive atomic nucleii together. Such a freedom of movement of electrons provides a means whereby a flow of electricity may take place through a crystal upon application of an external potential. Such an applied potential tends to accelerate the electrons and causes them to flow in the directions of the positive side of the potential.

✦ ✦ ✦

ELECTRICAL resistance results from any cause which restricts or restrains the transfer and flow electrons.

✦ ✦ ✦

TWO important obstructive factors are:

1. **Resistance inherent in the metal and originating from:**
   - (a) **Collision of valence electrons with oscillating atomic nucleii.**
   - (b) **By the extent to which the valence electrons are bound by adjacent atomic nucleii.**
2. **Resistance arising from extraneous or environmental circumstances such as:**
   - (a) **Foreign (stranger) atoms that occur as impurities or are intentionally added as in solid solutions.**
   - (b) **Internal stresses that distort and interrupt the energy levels at which electron transfer occurs.**

✦ ✦ ✦

Norbury in studying the effect of 1 per cent of various added elements to pure copper, gold and silver found that the resulting resistance due to a given added metal was greater the farther the elements were removed in the Periodic Table.

(Please turn to page 797)

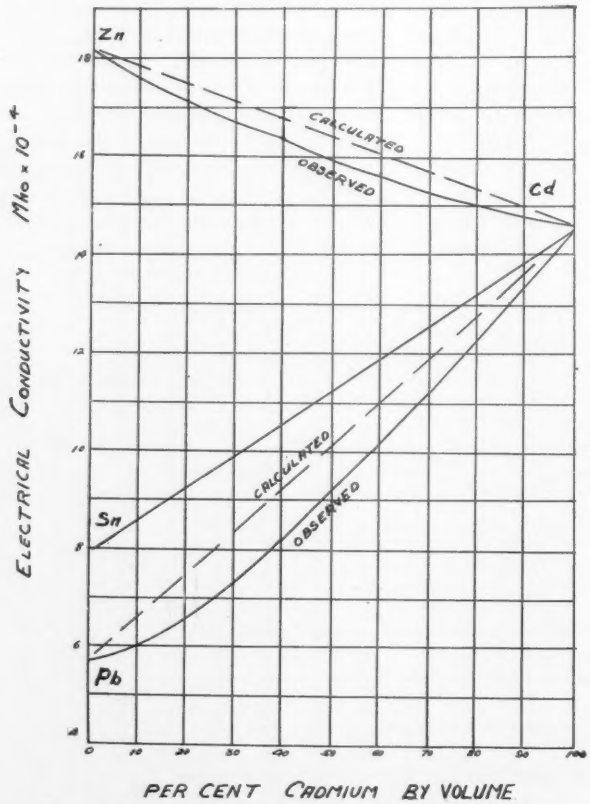

Fig. 10. Electrical Conductivity of Some Cadmium Alloys. ✦ ✦

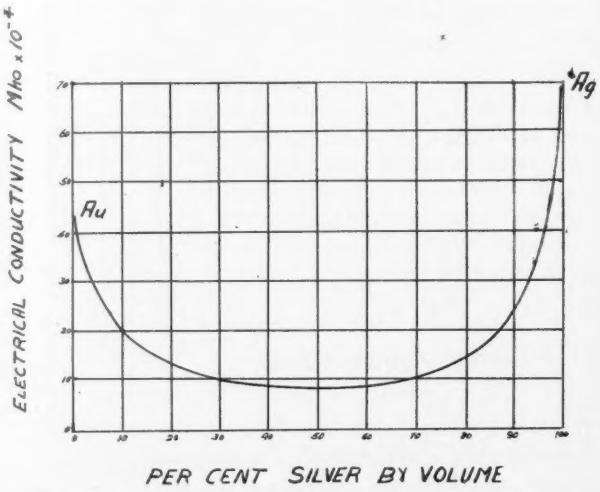

Fig. 11. Conductivity of the Gold-Silver Alloys. ✦ ✦ ✦

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✦ ✦ ✦

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YOU ARE CORDIALLY WELCOMED

to the 1945

WIRE ASSOCIATION CONVENTION!

In this momentous, history making victory year of 1945 the Wire Industry will foregather in Chicago at the LaSalle Hotel, from October 15th through the 18th, to participate in an exceptionally fine series of technical sessions and to re-appraise the problems of production in the light of the new conditions that peace imposes on our industry.

Besides the technical sessions, ample opportunity is afforded to members to meet with others and exchange ideas on many technical and practical questions that do not lend themselves to discussion in meetings. These exchanges of views between wire men and between them and equipment and material suppliers have often led to the development of new equipment and processes in such manner as to bring about notable advances in production techniques.

It is sincerely hoped that as many as possible of the wire industry, producers and suppliers, will take this occasion to attend and profit by the facilities of the Convention to further the interests of the industry in getting off to post-war production on the right foot. Your attendance at and participation in the affairs of the Convention will help to lay a firm foundation for a sound future for our industry.

Remember the time, the place and the date, and

BE THERE!

THE WIRE ASSOCIATION

RICHARD E. BROWN, Executive Secretary

300 MAIN STREET STAMFORD, CONN.

THE WIRE ASSOCIATION

Vice-President
R. M. HUSSEY
Superintendent, Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

President
D. D. BUCHANAN
Manager of Operations
Union Drawn Steel Division
Republic Steel Corp.
Massillon, Ohio

Vice-President
E. W. GUNDSTROM
Assistant Plant Manager
Rome Cable Corp.,
Rome, New York

RICHARD E. BROWN, Executive Secretary
300 Main St., Stamford, Conn.

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Ralph K. Clifford, Vice President, Continental Steel Corp., Kokomo, Ind.

Carl Johnson, Supt., Rod & Wire Mills, Bethlehem Steel Company, Sparrows Point, Md.

F. A. Westphal, Commander, U. S. N. R., Washington, D. C.

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Sidney Rolle, Asst. Mgr., Scomet Engineering Co., New York, N. Y.

Leroy D. Seymour, Supt., Wire Division, John A. Roebling's Sons Co., Roebling, New Jersey

✦ ✦ ✦

THE Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

THERE are separate divisions for all the separate major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

✦ ✦ ✦

PURPOSES

ITS specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members.

✦ ✦ ✦

ACTIVITIES:

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

THE WIRE ASSOCIATION

– 1945 –

RICHARD E. BROWN
Secretary, The Wire Association
Publisher, WIRE AND WIRE PRODUCTS
Stamford, Conn.

✦ ✦ ✦

D. D. BUCHANAN
Manager of Operations,
Union Drawn Steel Div., Republic Steel Corp.
President, The Wire Association

Associated with Union Drawn Steel for past twenty years. He has served in present capacity as manager of operations since 1939. During perjod 1930-1939 assistant general manager, and prior to 1930 manager of No. 3 plant at Beaver Falls. He started at Cambria Steel Company, Johnstown, Pa., in open hearth and rolling mills departments. Later he was connected with Jones & Laughlin Steel Company, South Side, Pittsburggh, Pa., and with See-Seldon, industrial engineers, in Pittsburgh.

✦ ✦ ✦

JOHN C. CALLAGHAN
Works Manager, Canada Works, Steel Co. of Canada. Vice President, The Wire Association.

THE MORDICA MEMORIAL LECTURER
1945

✦ ✦ ✦

A. L. ZAPP
Chairman of Dinner Committee

Attended Franklin & Marshall College, The United States Naval Engineering School, and Stevens Institute of Technology. Served two years as Engineering Officer in U. S. Navy. Five years in the Research Division of the Allied Chemical and Dye Corp. Four years with the Reily-Stoker Corp. Three years with Union Wire Die Corp. From 1932 with the Firth-Sterling Steel Company as manager of the Firthaloy Division. ✦ ✦

E. W. GUNDSTROM
Assistant Plant Manager,
Rome Cable Corporation, Rome, N. Y.
Vice President, The Wire Association

Born May 30, 1889. Received mechanical engineering education in his native land, Sweden. Upon arrival in the United States in 1911, was engaged by the General Electric Co., in Schenectady, first in designing work, later in their research laboratories. In 1917 he became connected with the Rome Wire Co., Rome, N. Y., as Assistant Plant Engineer. Became Plant Engineer in 1925, severed connection with this company in 1936 to assist in the organization of the Rome Cable Corporation, Rome, N. Y. In 1937 was made Assistant Plant Manager and also in charge of all plant engineering.

✦ ✦ ✦

KENNETH B. LEWIS
Chairman, Ferrous Division,
The program Committee, 1945

Consulting Wire Mill Engineer, Worcester, Mass. The Wire Association Mordica Memorial Lecturer for 1941. Born Bridgewater, Mass., and educated public schools, Quincy, Mass. A.B. Harvard University From 1904 to 1907 with Bethlehem Steel Company, becoming Asst. Supt. of open-hearth furnace. From 1907-1909 with the American Steel & Wire Company, Worcester, experimental work on wire. From 1909-1932, Morgan Construction Company, building wire mill equipment. In 1932 established own practice as Consulting Engineer in which occupation he is now engaged. ✦ ✦

PROGRAM

Wire Association Victory Convention

Chicago, Ill., October 15-18, 1945 — Association Headquarters—La Salle Hotel

Wire Association Headquarters at The La Salle Hotel
Will Be Open from Monday, October 15, All Day and Every Evening During the Convention
—Come and Get Acquainted!

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE TECHNICAL SESSIONS AND INFORMAL MEETINGS

✦ ✦ ✦ ADMISSION WILL BE BY BADGE ONLY ✦ ✦ ✦

Open Discussions Will Be Held on the Papers Presented and These Discussions Will Be Published in the January, 1946, Issue of Wire and Wire Products

PROGRAM COMMITTEE

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Consulting Wire Mill Engineer,
Worcester, Mass.
Chairman Ferrous Division

Sidney Rolle, Assistant Manager,
Scomet Engineering Corp.,
New York, N. Y.
Chairman Non-Ferrous Division

E. W. Gundstrom, Assistant Plant Mgr.,
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Chief Metallurgist,
Wickwire-Spencer Steel Co.,
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Superintendent, Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

E. W. Clark,
Vice Pres. & Cons. Eng.,
Syncro Machine Co.,
Perth Amboy, N. J.

Richard E. Brown,
Editor and Publisher,
"Wire and Wire Products",
Stamford, Con.

Hotel reservations should be made by members of the Wire Association direct to the Secretary — MAKE YOUR PLANS NOW TO ATTEND AND SEND YOUR RESERVATION IN PROMPTLY.

MONDAY, OCTOBER 15

10:30 A. M.
DIRECTORS' MEETING

12:30 P. M.
PROGRAM COMMITTEE LUNCH

Registration and Information at The La Salle Hotel—October 15-18—in charge of
Mrs. R. S. Spengel, Secy.-Treas., WIRE & WIRE PRODUCTS.

— The Technical Sessions —

The Discussions and the Mordica Memorial Lecture Will be Printed in the January, 1946 Issue of Wire and Wire Products

MONDAY, OCTOBER 15

Dr. S. A. Braley,
Director of Research,
Stainless Steel Products,
Pittsburgh Steel Company,
Pittsburgh, Pa.

Chairman of Meeting

Afternoon Session — 2:30 P. M.

Opening Address

D. D. Buchanan,

President, The Wire Association

Cleaning and De-Whiskering Nails
by N. Ransohoff, President
The Ransohoff Company,
Cincinnati, Ohio

Molten Salt Baths for the Wire Industry
by F. R. Morral, Metalurgist,
American Cyanamid Company,
Stamford, Conn.

Submerged Combustion,
by H. N. Snowden, Works Manager,
Seneca Wire & Mfg. Co.,
Fostoria, Ohio

TUESDAY, OCTOBER 16

B. L. McCarthy,
Chief Metallurgist,
Wickwire Spencer Steel Co.,
Buffalo, N. Y.

Chairman of Meeting

Morning Session — 9:30 A. M.

Elastic Properties of Steel Wire
Intended for Springs and
Formed Parts
by N. C. Talmadge,
Engineering Dept.
L. A. Young Spring Co.
Detroit, Mich.

Reduction of Area Values As a
Guide to Patenting
by D. A. Sutch, Metallurgist, and
B. L. McCarthy, Chief Metallurgist,
Wickwire Spencer Steel Co.,
Buffalo, N. Y.

TUESDAY, OCTOBER 16

L. D. Seymour,
Superintendent, Wire Mills
John A. Roebling's Sons Co.,
Roebling, N. J.

Chairman of Meeting

Afternoon Session — 1:30 P. M.

Annealing High Carbon Wire Stock
by J. H. Loux, Engineer,
Salem Engineering Co.,
Salem, Ohio

Herman Galvanizing Process
by Rowland Hussey, Supt. Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

WEDNESDAY, OCTOBER 17

Kenneth B. Lewis,
Consulting Wire Mill Engineer,
Worcester, Mass.

Chairman of Meeting

Morning Session — 10 A. M.

Preparing Rod Surfaces for Drawing
by H. L. Trembicki, Manager,
Metal Coating Division
Magnus Chemical Company,
Cleveland, Ohio

THE MORDICA MEMORIAL LECTURE

To Be Presented By

John C. Callaghan
Works Manager, Canada Works,
Steel Company of Canada, Ltd.,
Hamilton, Ontario, Canada

WEDNESDAY, OCTOBER 17

WIRE ASSOCIATION LUNCHEON — HOTEL LA SALLE 1:00 P. M.

Guest Speaker: L. S. Hamaker, Asst. Gen'l. Mgr. of Sales, Republic Steel Corp.

Topic: "An Appraisal of the General Business Outlook"

(Members are at liberty to bring guests. Ladies are welcome)

3:00 P. M.

Working Habits of Beryllium Copper Wire
by Matthew J. Donachie, Metallurgist,
Beryllium Corporation of Penna.,
Reading, Pa.

4:30 P. M.

Wire Association Annual Meeting
D. D. Buchanan,
President of the Wire Association

Presiding

WEDNESDAY, OCTOBER 17

Chairman
A. R. ZAPP,
Manager Carbide Division,
Firth-Sterling Steel Company,
McKeesport, Pa.

ANNUAL DINNER — STAG SMOKER — HOTEL LA SALLE

"GET TOGETHER" — 6:00 P. M. — DINNER — 7:00 P. M.

THURSDAY, OCTOBER 18

K. H. Davis, President,
K. H. Davis Wire & Cable Corp.,
Los Angeles, Cal.

Chairman of Meeting

Morning Session — 9:45 A. M.

Insulating Wires with Vinyl Resins,
by Dr. Carl L. Shapiro, President
General Materials Research Laboratories,
Beaver Falls, Pa.

Measuring Wire Stiffness by Low Stress Elongation,
by C. B. Shopmyer, et al,
General Electric Company,
Schenectady, N. Y.

THURSDAY, OCTOBER 18

Sidney Rolle, Asst. Manager,
Scomet Engineering Company,
New York, N. Y.

Chairman of Meeting

Afternoon Session — 1:30 P. M.

Metallurgy of Copper and
Its Relation to Magnetic Wire Manufacture
by W. L. Fleischmann, Section Engineer,
General Electric Company,
Fort Wayne, Ind.

Trends in Metallurgy,
by A. Pirk, Metallurgist.
Rome Cable Corporation,
Rome, N. Y.

THE WIRE ASSOCIATION MEDAL AWARDS

For the Most Meritorious Paper on Wire Manufacture or Fabrication During the Year.

— BY A MEMBER OF THE WIRE ASSOCIATION —

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Convention.

✦ ✦ ✦

AN annual medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

✦ ✦ ✦

CONSIDERATION for the Medal Awards is not limited to the papers presented at the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

✦ ✦ ✦

ALL papers submitted become the property of the Wire Association and the Board of Directors constitutes the Committee on Awards.

✦ ✦ ✦

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Program Committee and the Board of Directors of the Wire Association.

MEDAL AWARDS

1934 — EDWARD J. P. FISHER
Metallurgist, Keystone Steel & Wire Co., Peoria, Ill.
Title of Paper: "COLD DAWN STEEL SPRING WIRE"

1935 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "GRAIN SIZE AND ITS INFLUENCE ON THE MANUFACTURE OF STEEL WIRE"

1936 — ROBERT NOTVEST
Chief Engineer, Welding Division, J. D. Adams Mfg. Co., Indianapolis, Indiana
Title of Paper: "STEEL FOR ARC WELDING ELECTRODES"

1937 — BENJAMIN LEWIS McCARTHY
Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"ABNORMAL GRAIN GROWTH AND THE ANNEALING OF LOW CARBON STEEL WIRE"

1938 — WALTER R. BLOXDORF
Metallurgist, The MacWhyte Co., Kenosha, Wis.
Title of Paper: "WIRE ROPE"

1939 — STANLEY P. WATKINS
Manager, Sales Development, Rustless Iron and Steel Corp., Baltimore, Maryland
Title of Paper:
"THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"

1940 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Company, Atlanta, Georgia
Title of Paper:
"GALVANIZING CHARACTERISTICS OF DIFFERENT TYPES OF STEEL"

1941 — CARLETON W. GARRETT
Wire Mill Metallurgist, Jones & Laughlin Steel Corp., Aliquippa, Pennsylvania
Title of Paper:
"A BRIEF DISCUSSION ON THE MANUFACTURE OF STEEL FOR ARC WELDING ELECTRODES"

1942 — LEROY DEVOE SEYMOUR
Asst. Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada
Title of Paper:
"SCHEDULING AND PLANNING THE WIRE MILL FOR WAR PRODUCTION"

1943 — JOHN C. AIKEN
Asst. Supt., Rod and Wire Mills, Jones & Laughlin Steel Corp., Aliquippa, Pa.
Title of Paper: "DRAWING HIGH SPEED ROPE WIRE"

HONORABLE MENTIONS

1935 — L. D. SEYMOUR
Metallurgist, Rod and Wire Dept., Youngstown Sheet & Tube Co., Youngstown, Ohio
Title of Paper: "COLD HEADING WIRE"

1935 — R. A. SCHATZEL
Superintendent, General Research Laboratories, General Cable Corp., Rome, N. Y.
Title of Paper: "HARD AND SOFT COPPER WIRE"

1936 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"PLASTIC DEFORMATION IN WIRE DRAWING"

1937 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Co., Atlanta, Ga.
Title of Paper:
"A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING"

1937 — ALLAN B. DOVE
Chemical Engineer, Canada Works, The Steel Company of Canada, Ltd., Hamilton, Ont., Canada
Title of Paper:
"A. C. ELECTRO PICKLING—A BETTER METHOD OF PICKLING"

1938 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Massachusetts
Title of Paper: "RESILIENCE OF SPRINGS"

1938 — JOSEPH A. DOYLE
Vice President, W. S. Rockwell Co., New York, N. Y.
Title of Paper: "HEATING COPPER WIRE BARS"

1940 — H. BLOUNT and J. D. WILTRAKIS
Mfg. Engineer, Point Breeze Works, Engineer, Kearny Works, Western Electric Company
Title of Paper:
"DESIGN AND OPERATION OF A NEW COPPER WIRE DRAWING PLANT"

1941 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Massachusetts
Title of Paper:
"TIME, TEMPERATURE AND SIZE IN THE HEATING OF STEEL WIRE"

1942 — COLONEL FRANK W. BULLOCK
Signal Corps, United States Army
Title of Paper: "THE WIRE INDUSTRY IN WAR"

1943 — E. J. CRUM
General Foreman, Bethanizing and Galvanizing Departments, Bethlehem Steel Company, Sparrows Point, Md.
Title of Paper: "THE GRAPHICAL SOLUTION OF WIRE MILL MATHEMATICAL PROBLEMS"

THE WIRE ASSOCIATION
– PAST PRESIDENTS –

RALPH K. CLIFFORD
Vice President and General Manager,
Continental Steel Corp., Kokomo, Ind.
Past President, The Wire Association

Mr. Clifford began his career with the Kokomo Steel & Wire Company in 1907. In 1916, after graduating from the University of Michigan, he was named chief chemist at the Kokomo plant and in 1925, general superintendent. In 1937 he became works manager of Continental Steel Corporation at Kokomo and in 1940 he was elected Vice President in Charge of Operations. He became a director of the corporation in 1941 and a member of the executive committee in 1943. In March, 1944, he was elected Vice Prsidnt and General Manager of the Corporation. ✦ ✦

FREDERICK A. WESTPHAL
Lieut. Commander, U. S. N. R.
Past President, The Wire Association

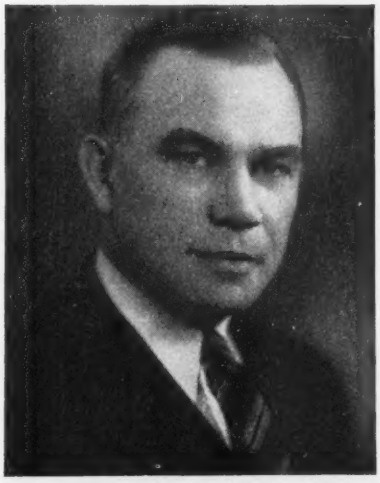
Born in Holyoke, Mass., in 1895, Lieut. Commander Westphal was educated at the U. S. Naval Academy, and was employed for four years by the American Steel and Wire Company. In 1932 he became Assistant Superintendent of the Rod & Wire Works of the Jones & Laughlin Steel Corporation at Aliquippa, Pa., and in 1928 became superintendent of Wire Mills, Sheffield Steel Corporation, Kansas City, Missouri. He was later transferred to Houston, Texas, as Works Manager of the Sheffield Steel Corporation of Texas. At present he is a Lieutenant Commander in the United States Naval Reserve on active duty. ✦

JOHN MORDICA
1873-1937

John Mordica, who was the first president of the Wire Association, was Superintendent of the Sparrows Point Rod and Wire Mill of the Bethlehem Steel Company from 1925 until his death in 1937. He had much to do with the starting and successful growth of the Wire Association. ✦ ✦

J. K. BEESON
Executive Vice President.
Pittsburgh Steel Company
Past President, The Wire Association

After graduating from Yale University in 1929, Mr. Beeson joined the Pittsburgh Steel Company and worked in the Research Department making a thorough study of wire specialties for a period of five years. In 1935 he was made manager of manufacturer's products sales, and one year later was made assistant superintendent of the Monessen Works. In 1938 he became assistant manager of sales, and in 1939 was appointed assistant general manager of sales which position he held until his new appointment. He was elected Vice President in Charge of Sales of Pittsburgh Steel Company at a meeting of its Board of Directors on March 31, 1941, and held this position until his entry in the Army as a captain in the Air Corps. Recently discharged with the rank of Lieut. Colonel, he was elected Executive Vice President of the Pittsburgh Steel Company. ✦ ✦ ✦ ✦ ✦



CARL E. JOHNSON
Supt. Rod & Wire Mills,
Bethlehem Steel Company,
Sparrows Point, Maryland
Past President, The Wire Association

Born Marquette, Mich. Graduate Mining Engineering, Michigan College of Mines (Now Michigan College of Mining and Technology) Houghton, Mich., 1923. While student spent one year working underground and in the open pit mines of the Marquette and Mesabi Iron Ranges. 1923-1925 open hearth department, Bethlehem Steel Company. 1925-1926, Construction Department, Bethlehem Steel Company during construction of wire mill. Upon its completion in 1926 became Assistant Superintendent. In 1937 appointed Superintendent of Rod and Wire Mills. ✦ ✦ ✦ ✦

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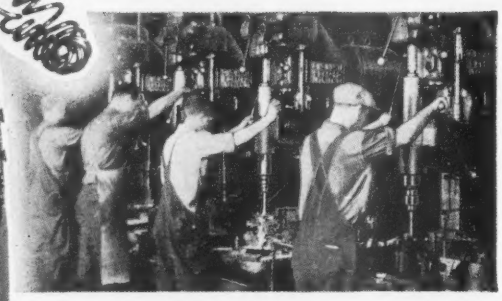
(Please turn to page 782)

To Have and to Hold for the Life of the Garment . . .



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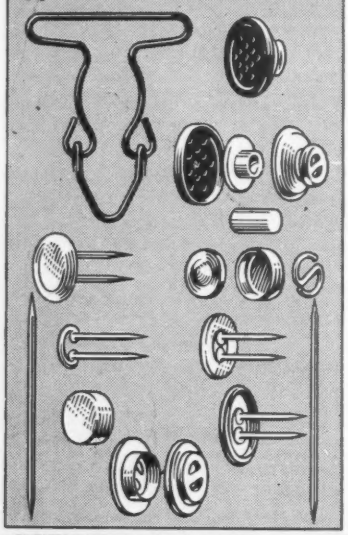

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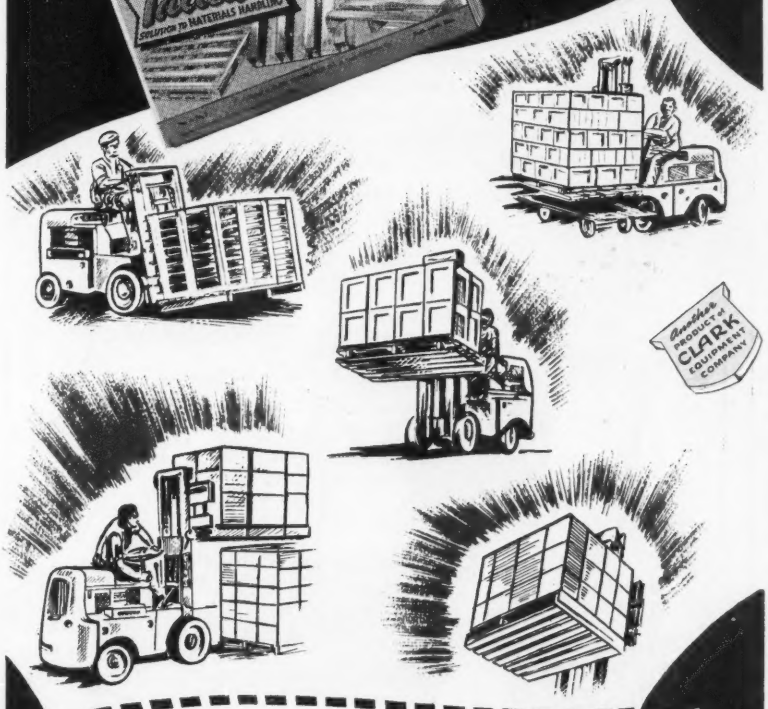

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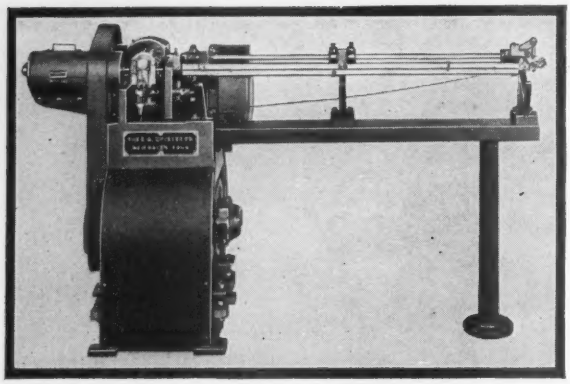

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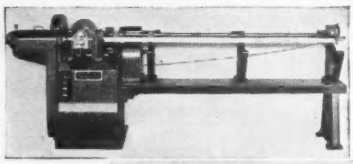

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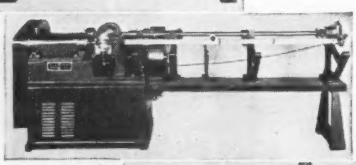

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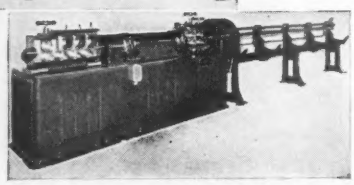

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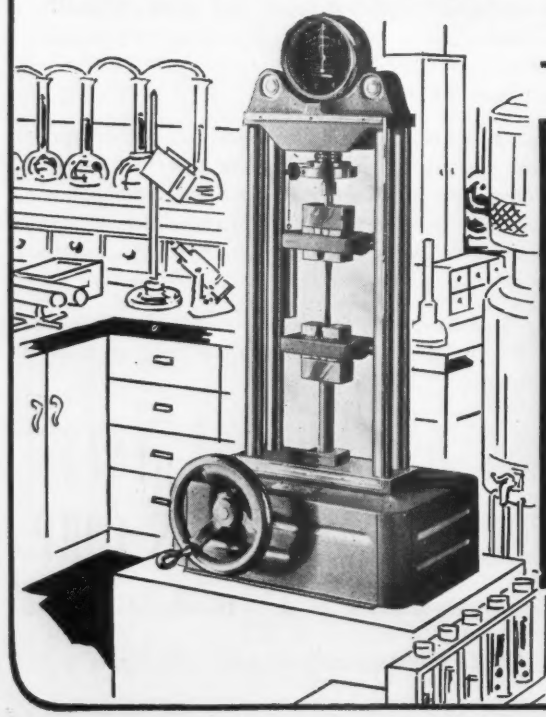

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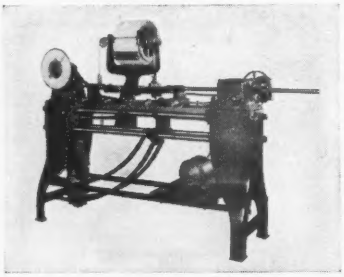

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(Please turn to page 792)

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(Continued from page 791)

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ZUR, JOHN P., Met. Engr.,
Trauwood Engineering Company,
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Addenda

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Members of the Wire Association are requested to read this membership list over carefully and to mail in at once to the Secretary of the Association any changes in title, company or address, which may be necessary.

✦ ✦ ✦

— NOTICE —

The following convention papers were not received in time for preprinting in the October issue of Wire & Wire Products. They will be published in the November and December issues.

✦ ✦ ✦

Preparing Rod Surfaces for Drawing
by H. L. Trembicki, Manager,
Metal Coating Division,
Magnus Chemical Company,
Cleveland, Ohio

✦ ✦ ✦

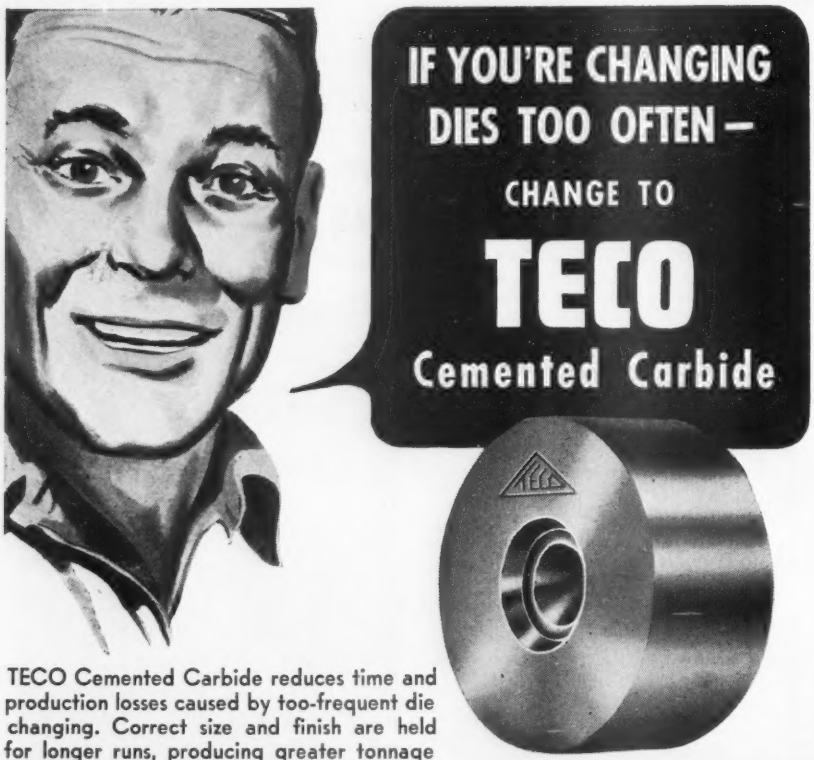
Herman Galvanizing Process
by Rowland Hussey, Supt. Wire Dept.,
Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

✦ ✦ ✦

Metallurgy of Copper and
Its Relation to Magnetic Wire Manufacture
by W. L. Fleischmann, Section Engineer,
General Electric Company,
Fort Wayne, Ind.

✦ ✦ ✦

Elastic Properties of Steel Wire
Intended for Springs and Formed Parts
by N. C. Talmadge,
Engineering Dept.,
L. A. Young Spring Co.,
Detroit, Mich.



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TECO
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CARBIDE DIES

Reduction of Area Values As a Guide to Patenting
by D. A. Sutch, Metallurgist, and B. L. McCarthy, Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.

✦ ✦ ✦

The Convention Proceedings to be published in the January, 1946 issue together with
THE MORDICA MEMORIAL LECTURE
as presented by
John C. Callaghan, Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada

$100,000,000 In Silver Lies In War Plant

IN 1942, when the government was building its largest aluminum reduction plant at Grand Avenue and Newtown Creek, Maspeth, Queens, copper was so scarce that silver was substituted in the electrical equipment.

✦ ✦ ✦

SIX thousand, five hundred tons of silver, having a value of nearly $100,000,000, went into wires and electrodes, the Reconstruction Finance Corp. disclosed recently.

THE silver is 99 per cent reclaimable, the R.F.C. said. It remained in the equipment, which has been stored at the plant since production was halted in May, 1944, with the passing of the aluminum shortage.

✦ ✦ ✦

Wire Working Machinery

MANUFACTURERS of wire stranders and cablers, coil and armature winders, spring coilers, and wire cloth looms comprise some 20 companies. Additional quantities are produced as secondary products by other manufacturers.

✦ ✦ ✦

WARTIME demands for steel wire rope, electric conductor cable, and electric motors precluded any important conversion of the wire working industry from its normal products, and permitted only a limited amount of war sub-contracting.

✦ ✦ ✦

INCREASED production was carried on by multiple shift operation rather than by expansion of facilities, except in one instance, manufacture of heavy armature servicing equipment for Navy use.

✦ ✦ ✦

DEMAND for wire working equipment for civilian end uses was reduced almost to the vanishing point by various limitation orders on manufacture of civilian wire products. The sole exception was for motor repair shops, which were forced to replace manual winder losses with armature winding machines. This additional civilian demand was only partially met until 1945, due to priorities for military end-use orders.

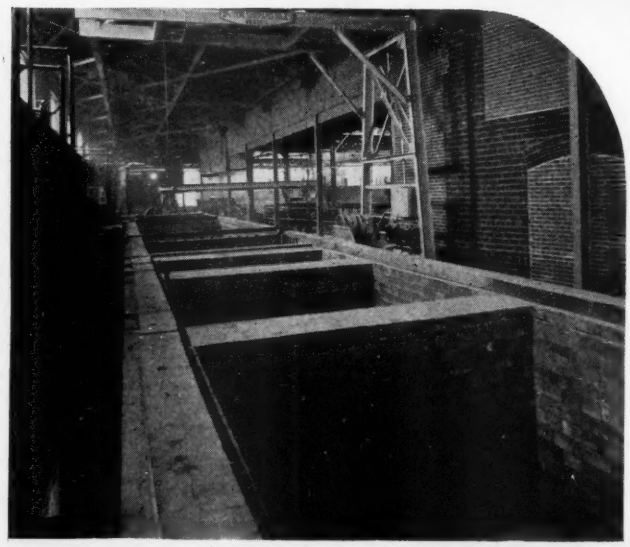
✦ ✦ ✦

PEAK production of wire working machinery is being established in the third quarter of 1945.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

WIRE & WIRE PRODUCTS

Trouble-free NUKEM ACID TANKS



Produce Repeat Orders!

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For information and prices on pickling tanks that will give you long, trouble-free service...write or wire. Our nearest representative will contact you...submit recommendations.

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Answers on Termination Problems
By J. T. R.

IF our present contract should be terminated, some of our sub-contractors would have very small claims. Are these subs required to file regular inventory forms in the same manner as those who have large claims?

✦ ✦ ✦

THE proposal form 1A, known as the short form, will be used by many primes and subs who have net claims of less than $1,000. If this form is used by either a prime or a subcontractor, it is required that he retain or dispose of all the termination inventory at the best price obtainable.

✦ ✦ ✦

NOTE that the net claim, not the gross claim, must be less than $1,000. For instance, your gross claim may be somewhat like this:

Supplies and Parts	$1000
Work in Process	3000
Other charges	500
Total	$4500

✦ ✦ ✦

SINCE you are using form 1A it is understood that you will retain or sell at the best price obtainable all the inventory. We will assume that your retention offer is:

Supplies and Parts	$ 900
Work in Process	2700
Total	$3600

✦ ✦ ✦

AFTER deducting your offer from the gross amount, your proposal will show a net claim of $900.

✦ ✦ ✦

THE phrase, "retain or dispose of all the termination inventory at the best price obtainable," should be clarified. It does not mean that you may say arbitrarily, "this is the best price," and proceed to retain or sell at that price.

✦ ✦ ✦

IF you are a subcontractor, you should discuss with your customer the price at which you plan to retain or sell the inventory because your customer must be satisfied with respect to your claim since it becomes a part of his settlement proposal.

✦ ✦ ✦

IF you are a prime contractor and want to use the 1A form, you will discuss the retention or sale price with the contracting officer to determine if your proposal is acceptable.

✦ ✦ ✦

WE have been informed that we do not have to list those items of termination inventory which we want to retain at cost. Is that correct?

✦ ✦ ✦

THE authority to retain termination inventory at cost is stated in J.T.R. (442.1) "A war contractor may retain or sell any item of termination inventory at its cost as stated in his termination inventory schedule. Reasonable freight, packing and handling charges on items sold may be included in the termination claim. Such retention or sale may be made without approval by the contracting officer or next higher tier war contractor."

✦ ✦ ✦

THIS paragraph does not state that you need not list items of termination inventory which you elect to retain at cost. There is a possibility that some items of termination inventory may be so-called critical

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PRODUCTION INCREASES UP TO 500%
In one single operation, this remarkable machine bores ALL the holes in a wooden cable reel head. In addition, it has the exclusive Root Patented Hydraulic Feed which provides a stepless range of feed from 2 to 29 strokes per minute. Operator is not handicapped by limited feed rate. This increases production tremendously. Can also be used for other boring purposes. Made in three sizes. Write for Bulletin No. 132.
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items. The Government may want to acquire such critical items for production or supply purposes and the contracting officer may direct that such items be transferred to the Government.

✦ ✦ ✦

IT would seem that in most cases it is to the contractor's advantage to list termination inventory, even though he does retain it or sell it at cost because there are certain expenses that the Government will pay in connection with termination inventories.

✦ ✦ ✦

HOWEVER, there may be an instance where, upon termination, the contractor says to the contracting officer: "I have so much inventory and my charges would be about so much if I prepared a proposal. I'm willing to clean this up quickly by keeping the inventory and waiving all charges against the Government." If the contracting officer accepts he will have the contractor sign a waiver and the case is closed.

✦ ✦ ✦

IS there a good definition of the phrase, "the best price obtainable," which is used in connection with the disposition of termination inventory?

✦ ✦ ✦

IN the case of a sale by the contractor, J.T.R. says it "means a sale at the best price offered after reasonable effort to test the market, having due regard for the principles stated in the price policies, and for the circumstances, nature, condition, quantity, and location of the particular material."

✦ ✦ ✦

IN the case of retention it "means a price that is fair and reasonable and not less than the net proceeds that could reasonably be expected to be obtained if the item were offered for sale."

✦ ✦ ✦

WE have been spending some money to set up a termination department and have been charging such items to a Termination Expense account. Our office manager says that we can allocate these costs as termination expenses when our contracts are terminated. Is there any authority in the law for this?

THE authority for allocating advance planning expenditures as legitimate termination costs seems to be clearly defined in Joint Termination Regulation (554) in these words: "Where a contractor incurs reasonable preliminary expenses to plan or prepare in advance for termination, such expenses may be allocated on any fair basis to contracts terminated thereafter."

✦ ✦ ✦

IT is certain that when termination is the cause of a claim that there will be included in the claim post termination charges. These include such settlement expenses as "reasonable accounting, legal, clerical and other expenses necessary in connection with the termination and settlement of the contract and subcontracts and purchase orders thereunder."

✦ ✦ ✦

THE point at issue seems to be this: If post termination charges will amount to a certain sum, is it better to spend that sum before termination or would we be in just as good a position by waiting until termination to incur such costs?

(Please turn to page 796)

AUTOMATIC STRAIGHTENING AND CUTTING MACHINES

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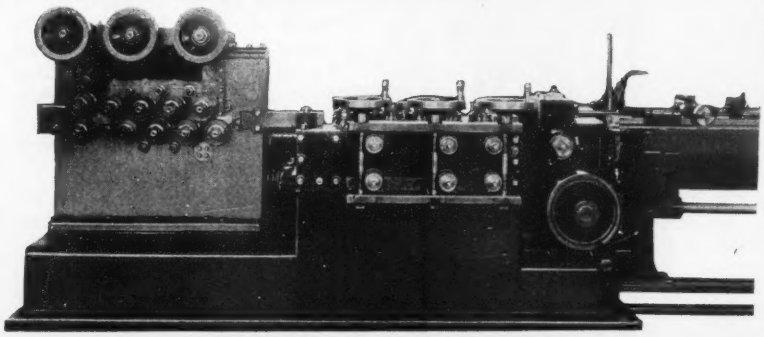


Will produce uniform quality material without marking. High production, with accurate lengths.

THE HALLDEN MACHINE CO.

THOMASTON, CONNECTICUT

Answers To Termination Problems

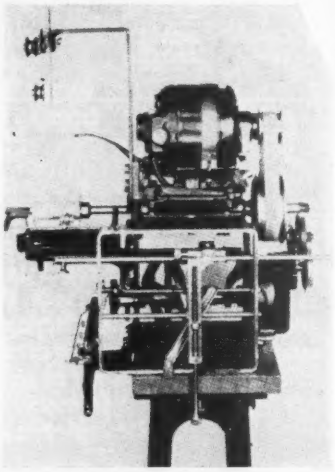
(Continued from page 795)

A STUDY of the problem indicates that the contractor should derive more benefit from advance planning than the Government. By planning in advance, setting up the termination procedure to be followed, having all the necessary forms ready, having made a pre-termination agreement as to the price and disposition of inventory, he will be in a position to say almost immediately to the contracting officer:

"Here is my settlement proposal. I have listed all inventory as specified in our agreement. The termination charges, or settlement costs, shown on the proposal have been allocated from our advance planning or Termination Expense account on such and such a basis. We have completed our part of this work, and we wait for your approval of this claim and final payment. In the meantime we are starting on civilian production so no time will be lost in getting our goods to our customers."

✦ ✦ ✦

STANDARD UNI-DRIVE WIRE WINDER



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IN contrast to this, let us visualize the problem of the contractor who gives no consideration to the termination problems until he receives notice of termination. He will list his inventory and then try to decide if he wants it and at what price, or if he wants to sell it or pass title to the Government. Even after he has decided what to do, it will take some time until both parties agree on every detail. In the meantime he is holding up production on his own items.

✦ ✦ ✦

THEN comes the matter of preparing his claim, calling accountants and possibly lawyers to do on the spur of the moment what might have been done leisurely months before. Since no advance agreement has been made on any of these items, he will be devoting much of his own time which he could use in planning for his future business.

✦ ✦ ✦

Page Steel & Wire Opens Detroit Office

Page Steel and Wire Division of American Chain & Cable Company, Inc., has established a new sales office in the General Motors Building, Detroit, Mich., in order to improve customer service. E. B. Brant and W. R. Stephens, formerly at the Page plant at Monessen, Pa., will make their headquarters in the Detroit office.

✦ ✦ ✦

R. S. Rose, District Sales Mgr., Latrobe Electric Steel

ROBERT S. ROSE has been appointed district sales manager of the new sales office which has been opened by Latrobe Electric Steel Company, of Latrobe, Pa., in Boston, Mass., at 10 High St.

✦ ✦ ✦

MR. ROSE is well known in New England, having been in tool steel sales in that area for the past nine years. He is a member of the American Society of Metals and of the American Institute of Mining and Metallurgical Engineers. A graduate of University of Pittsburgh, he also attended the Graduate School of Metallurgy at Carnegie Institute of Technology.

Trends In Metallurgy

(Continued from page 770)

Also the greater the valence of the solute (stranger atom) the greater is the increase in resistance. **Linde** has shown that on the addition of 1 per cent of indium, tin or antimony to silver the resistance varies as $(V-1)^2$ where V is the valence of the solute (stranger atom) and 1 is the valence of silver.

✦ ✦ ✦

Conclusion

THE foreging presentation is of necessity incomplete and very fragmentary. It does, however, aim to leave the impression that at least a working knowledge of the principles of physical metallurgy is necessary if the behavior of metals is to be understood and correlated in a useful and systematic manner.

✦ ✦ ✦

IT also becomes apparent that as our knowledge of the nature of matter becomes more complete and comprehensive that purely mechanistic conceptions are being replaced by mathematical concepts. I would like to leave with you the impression that science is not merely a matter of academic interest and concern, but that it is the source of all industry and the basis upon which the economy of the world is founded. That nation is most likely to become a potent force for international peace which fosters research and the application of research to industry and uses this power wisely and judiciously.

✦ ✦ ✦

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Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

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SEND YOUR RESERVATION IN NOW!

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JOIN THE . . . . WIRE ASSOCIATION

To those wire mill men who have not already joined the Wire Association for the mutual benefit of those engaged in the operating end of the Wire Industry, a cordial invitation is extended to become a member.

If you are making rods and wire—of steel, copper, brass, alloy or any ferrous or non-ferrous metal, or are in the wire products end—nails, bolts, screws, rivets, wire rope, wire cloth, springs, electric wire and cable or any of the numerous products made of wire, you will benefit by identifying yourself with the Association.

The Wire Association is a non-profit organization of wire and wire products mill superintendents, executives and foremen, whose specific purpose is to improve production methods and afford a clearing house for ideas on management, technical and research problems, and to develop and maintain friendly relations among members.

Dues are only $10.00 a year. This includes:

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The Technical, Catalogue and Correspondence Files of the Wire Association hold the answer to practically every "Where can I buy" problem. This service available to members without charge.

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THE WIRE ASSOCIATION

RICHARD E. BROWN, Executive Secretary

300 MAIN STREET — STAMFORD, CONN.

Outstanding Personalities of the Wire Industry

Capt. Frederick H. Parkin

FREDERICK H. PARKIN, Capt., 813th Tank Destroyer Battalion, has completed four and a half years of service with the armed forces in the European Theatre of Operations and has now received an honorable discharge from the Army. Having completed 32 months overseas, during which period he participated in front-line action in five major campaigns, he has received formal discharge notification from the Fort Dix Separation Center, where he was processed recently with 158 points.

✦ ✦ ✦

CAPTAIN Parkin left this country in August, 1942, and was among the first large contingents of American Troops to land in England. Following a brief period of training there, he sailed to Africa and participated in that campaign as a member of the 34th Division. During the Sicilian operation, he was in charge of 200 enlisted men from his bat-

CAPT. FREDERICK H. PARKIN,
Wm. H. Parkin Co., Pittsburgh, Pa.

talion who aided General Patton's army round up and process the thousands of German and Italian prisoners of war.

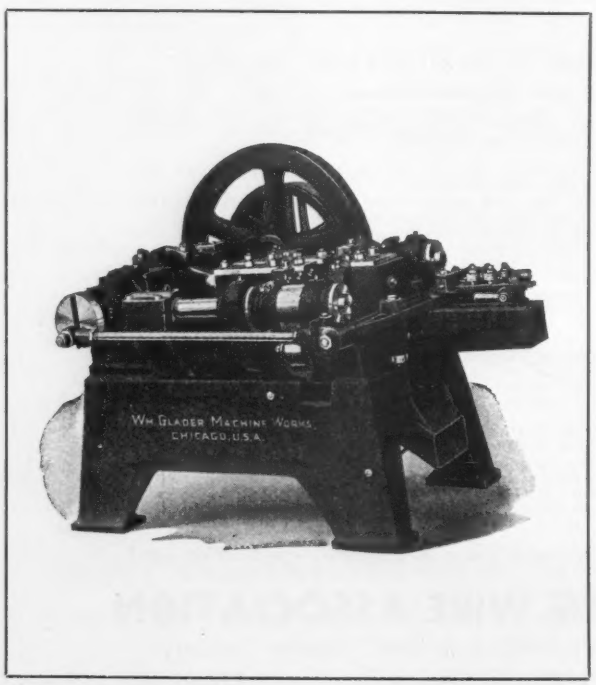
✦ ✦ ✦

HIS battalion landed in Normandy on D plus 20 last June, 1944 and there saw service with the 79th Infantry Division. From Normandy and its vicious hedgerows, across France with the Third Army, Captain Parkin's division then joined with the Seventh Army during the bitter Winter fighting in Alsace. During the Argentan-Falaise trap last Summer, he was cited with the Bronze Star award for leading a three-man patrol which effectively trapped and forced the surrender of over 30 Germans of the famed 2nd Panzer Division.

✦ ✦ ✦

CAPTAIN Parkin, while holding the position as executive officer of the battalion last Spring, was returned to the States for a 30-days recuperation furlough and happened to be in Pittsburgh when V-E Day was proclaimed. Returning to Fort Dix with full expectations of being sent back to Germany, he was among the first officers to be released under the army's discharge system.

GLADER HIGH SPEED WIRE NAIL MACHINE



High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS
210 NO. RACINE AVE.
CHICAGO 7, ILLINOIS

HE has returned to his former position with The William M. Parkin Company, Chemical Engineers to the Steel Industry, where he was employed for several years prior to induction in the Army.

✦ ✦ ✦

Matthew J. Donachie, Consulting Metallurgical Engineer, Holyoke, Mass.

MR. DONACHIE came to the United States in 1926—Attended the Technical College, Coatlridge, Scotland; also the Franklin Union Institute, Boston, Mass. Employed by Gilby Wire Company (new W. B. Driver Company) from 1926-1930, in the testing laboratory and development work. Metallurgical Engineer for General Alloy Company, Newark, New Jersey, from 1930-1931. In 1931 went to National Harris Alloy Company as Chief Metallurgical Engineer. In 1933 to George W. Prentiss Company, Holyoke, Mass.

MATTHEW J. DONACHIE

as Metallurgist. Also consultant to Beryllium Products Corporation, from 1935-1942. From 1942 to 1944 employed at Beryllium Corporation, Reading, Penna., as chief metallurgist and acting as technical director. Now acting as technical adviser and consultant for Beryllium Corporation.

✦ ✦ ✦

Youngstown Sheet & Tube Announces Changes

THE company announces appointment of **Jared F. Cone** as purchasing agent of machinery, construction and maintenance repair and operating supplies, effective August 15th.

✦ ✦ ✦

MR. Cone has been associated with Youngstown Sheet and Tube for the past 27 years. He has been assistant purchasing agent since 1929.

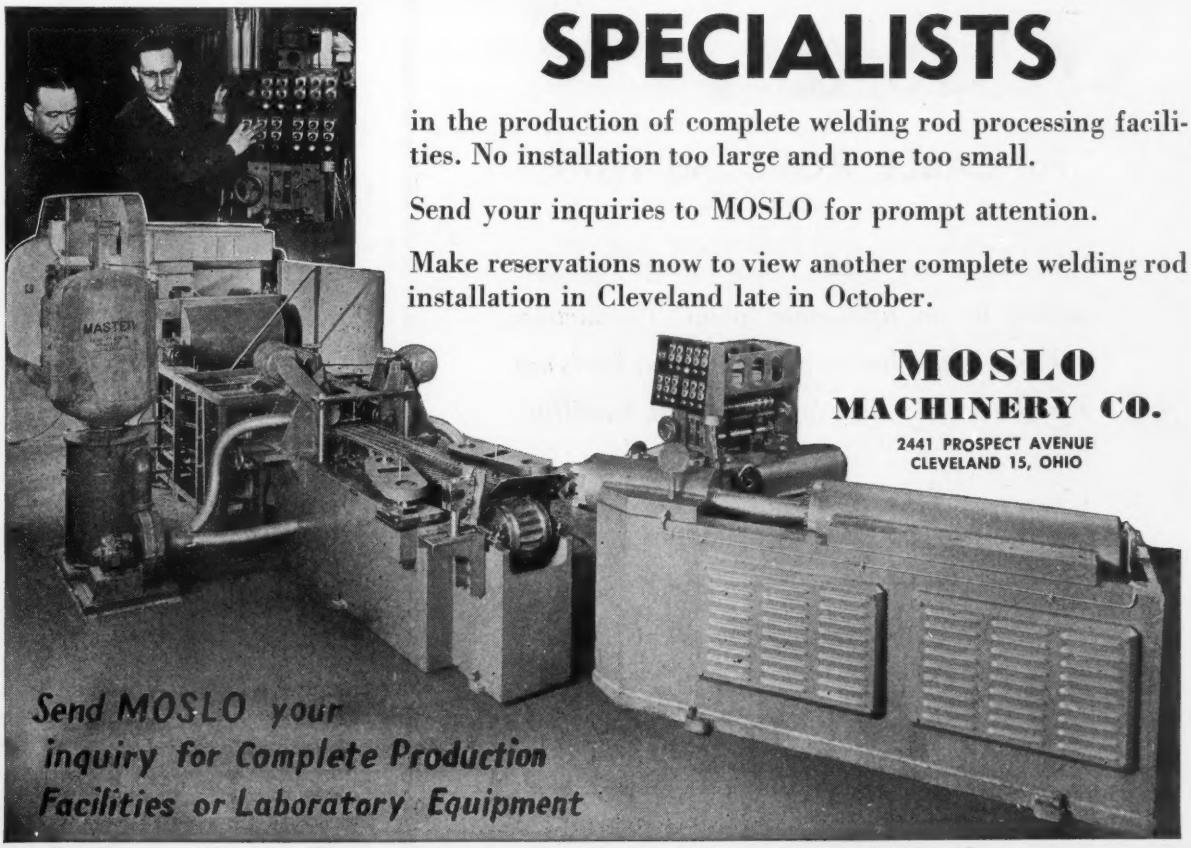
✦ ✦ ✦

JAMES D. SLOAN has been appointed purchasing agent of raw materials.

✦ ✦ ✦

HE has been associated with the company for the past 15 years. From February, 1942, until November, 1944, he had been "on loan" to Raw Materials Branch, Scrap Section of the War Production Board, Washington, D. C.

(Please turn to page 800)


SPECIALISTS
in the production of complete welding rod processing facilities. No installation too large and none too small.
Send your inquiries to MOSLO for prompt attention.
Make reservations now to view another complete welding rod installation in Cleveland late in October.
MOSLO
MACHINERY CO.
2441 PROSPECT AVENUE
CLEVELAND 15, OHIO
Send MOSLO your inquiry for Complete Production Facilities or Laboratory Equipment

Outstanding Personalities of the Wire Industry

(Continued from page 799)

Stanley P. Watkins
Market Development Manager
Rustless Iron and Steel Corp.

APPOINTMENT of **Stanley P. Watkins** as Manager of the Market Development Division of the **Rustless Iron and Steel Corporation** has been announced.

✦ ✦ ✦

FOR the last year Mr. Watkins has been Manager of the Sales Engineering Department at Rustless and prior to that time he was head of the Sales Development Department and also served as an engineer in that department.

✦ ✦ ✦

HE joined the Rustless organization in 1931. Watkins is a graduate of Birmingham Southern College and also studied metallurgy at Carnegie Tech. His first job at Rustless was as a metallurgist in the laboratory. He is a member of the Publications Committee of the American Society for Metals, is a past president of the Baltimore Chapter of this group, and is a member of the American Society for Testing Materials and the American Institute of Mining and Metallurgical Engineers. In 1939 he received the Annual Award of the Wire Association "for meritorious contributions to the advancement of the industry."

✦ ✦ ✦

Middeker Takes Hall's Place For Carboloy In New England

ON August 20th, **John W. Middeker** was made Sales and Service Engineer, representing Carboloy Company in the territory formerly served by B. W. Hall, resigned.

✦ ✦ ✦

MR. MIDDEKER, before joining the Carboloy organization, had over 20 years experience in the cold drawn industry. He has been with the Carboloy Company 2½ years, devoting all his time to the servicing of carbide dies of all types. He is thoroughly experienced in all phases of wire, bar and tube drawing.

✦ ✦ ✦

MR. MIDDEKER may be reached at Carboloy's Thomaston office, Thomaston, Connecticut; telephone: Thomaston 846.

✦ ✦ ✦

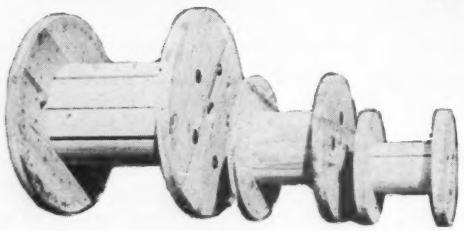
Emil C. Ostlund,
Chief Industrial Engineer
American Steel & Wire Corp.

EMIL C. OSTLUND has been appointed chief industrial engineer of American Steel & Wire Co., subsidiary of United States Steel Corp. He succeeds Cecil W. Guyatt, recently named assistant to the chairman of operating committees, United States Steel Corp. of Delaware.

✦ ✦ ✦

MR. OSTLUND was born in Brockton, Mass., on June 10, 1911, and was graduated from Worcester Polytechnic Institute with a B.S. degree in Mechanical Engineering. He has been employed by the Wire Company since October, 1936, when he started as an industrial engineer at Worcester, Mass. He was subsequently works industrial engineer and district industrial engineer at Worcester before being transferred to Cleveland in December, 1943, as assistant chief industrial engineer, which position he has held up to the present time.

WOODEN . . . REELS



RETURNABLE and NON-RETURNABLE

For CABLE, ROPE and WIRE

(from 12" to 96" in diameter)

These reels are made to customers' specifications in an up-to-date plant. Production methods assure lowest possible costs. Reels are sturdy and will withstand severest handling.

We can also make your reel heads for steel drums

Let us quote on your requirements

The BRIDGE MFG. CO., Inc.

HAZARDVILLE, CONN.

Thomas R. Akin

THE death of Thomas R. Akin, president of the Laclede Steel Company and a director of St. Louis Union Trust Company and the First National Bank in St. Louis, has been announced. He was 77 years old.

✦ ✦ ✦

A NATIVE of New Bedford, Mass., Mr. Akin came to St. Louis in 1878. He was a graduate of the old Smith Academy and of Harvard University. Following his graduation, he worked for steel companies at Belleville, Ill., and Alexandria, Ind., and then for the Ansonia Copper and Brass Company, at Ansonia, Conn. He became associated with the old Republic Iron and Steel Company, now the Republic Steel Corporation, in 1901, remaining with it for ten years.

✦ ✦ ✦

IN 1911 he resigned as manager of western mills of Republic to found the Laclede Steel Company here. The firm now operates mills in Madison and Alton.

✦ ✦ ✦

MR. AKIN was a director of the American Iron and Steel Institute, past president of the Harvard Club of St. Louis.

✦ ✦ ✦

SURVIVING are his wife, Mrs. Grace Niccols Akin, and two sons, William M. Akin and Thomas R. Akin, Jr., both of Alton.

✦ ✦ ✦

Arthur Slepian
President
The Universal Wire & Cable Co., Ltd.

MR. ARTHUR SLEPIAN has been named President of **The Universal Wire & Cable Co., Ltd.,** of Montreal, Quebec, Canada. Mr. Slepian, who recently resigned as Vice President and General Manager of The Wheeler Insulated Wire Co., Inc., of Bridgeport, Connecticut, has been very active and well known in the Electrical, Radio and Lighting Industries. He is an associate of the American Institute of Electrical Engineers and the Illuminating Engineering Society, and during the war has served the War Production Board in an advisory capacity as a member of the Radio and Radar Transformer and Fluorescent Lighting Ballast groups. Mr. Slepian is also a member of the Fleurolier Advisory Committee.

✦ ✦ ✦

THE Universal Wire & Cable Co., Ltd., are manufacturers of Transformers, Coil Windings, Ballasts and Specialties for the Electrical, Radio and Lighting Industries, and are planning an expansion program throughout the British Empire.

✦ ✦ ✦

Chatten New Philips General Commercial Manager

Louis J. Chatten who resigned July 31st as Director of the Radio and Radar Division of the War Production Board in Washington, has been appointed Vice President and General Commercial Manager of **North American Philips Company, Inc.** He assumed his duties September 1st.

(Please turn to page 802)

DIAMOND and CARBIDE
WIRE DRAWING DIES

Since the erection of a large new building in 1942, the demand for Fort Wayne dies for wire drawing has increased so that in this Victory Year of 1945 it has been necessary to enlarge our plant by fifty per cent.

In addition to our regular line of DIAMOND DIES, we are now furnishing TUNGSTEN CARBIDE DIES, finished to specifications. A complete line of DIAMOND POWDERS are carried. Diamond and carbide dies refinished.

The name "FORT WAYNE" stands for the finest in quality and craftsmanship. Our customers can expect courteous and cooperative service on every order and we strive to make each die so well that it will merit your continued patronage and good will.

Range of Sizes
Diamond: .0003" to .102"
Carbide: .003" Up

You are invited to consult us on all your diamond and carbide die problems. Please write or call:

FORT WAYNE WIRE DIE COMPANY
2625 EAST PONTIAC STREET FORT WAYNE, INDIANA
Telephone: Harrison 4319

Outstanding Personalities of The Wire Industry

(Continued from page 801)

F. J. Laskey
Manager of Purchases
Republic Steel Corp.

FRANK J. LASKEY, general purchasing agent of Republic Steel Corporation and a former Youngstown man, has been named manager of purchases and raw materials.

✦ ✦ ✦

A NATIVE of Rock Creek, Ohio, Mr. Laskey began his business experience with General Fireproofing in Youngstown in 1906. He left GF's purchasing department in 1917 to become purchasing agent of Liberty Steel Co., Warren. In 1919, he became general purchasing agent of the then newly organized Newton Steel Company of Youngstown and Newton Falls. As a result of various mergers, he served successively with Corrigan McKinney Steel Co. and then Republic.

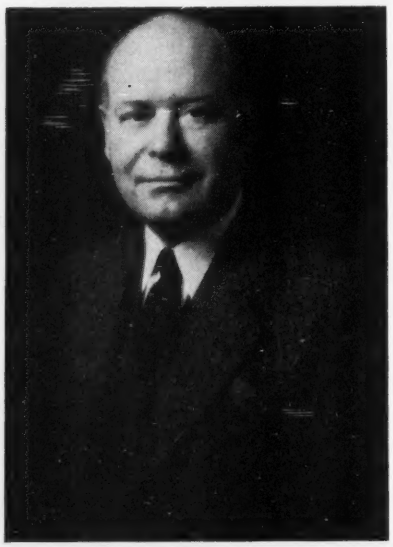
✦ ✦ ✦

MR. LASKEY succeeds Carl A. Ilgenfritz, who left Republic September 1st to become vice-president in charge of purchases for Carnegie-Illinois Steel Corporation. Mr. Laskey is being succeeded by William T. Adams, now chief electrical buyer of Republic.

✦ ✦ ✦

Albert B. Fritts,
Advertising Manager,
The Norton Co.

ONE of the most widely known advertising men in New England, Albert B. Fritts, retired from active duty October 1 after 45 years' experience in the industrial field. Thirty-seven years of that activity was with Norton Company of Worcester, Massachusetts.



ALBERT B. FRITTS

MR. FRITTS' advertising experience dates back to the beginning of the Spanish War in 1898. He recalls reading the headlines announcing the sinking of the battleship "Maine" while waiting at a small New Jersey town railroad station when on an errand for the weekly newspaper. About 1900 he changed his scene of activity to New York City where he worked with Charles Austin Bates, often referred to as the father of modern advertising. Later he became connected with the Hill Publishing Company, publishers of "American Machinist," "Power" and "Engineering and Mining Journal."

✦ ✦ ✦

IN 1908 he joined Norton Company in Worcester, Massachusetts and

All-Metal WIRE SPOOLS

CABLE SPOOLS . . . for Insulated and Rubber Covered Wire, Solder, and similar products.

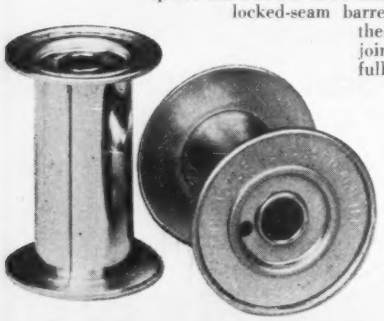
These spool ends are formed from cold rolled steel of gauges to meet specific demands for strength. The edges are curled and ribs embossed for increased rigidity. Panels may be worked into your design and embossed, for use in marking size and variety. All parts are lithographed for identification purposes and to protect the metal.

Ends and traverses may be shipped unassembled. A simple operation on a hand, foot, or power press makes rigid and permanent assembly.

Made in 5", 6½" and 10½" diameter Ends; Traverses 1 15/16" diameter (or special 3½" diameter for 10½" End), in any desired lengths.

FINE WIRE SPOOLS . . . for winding and shipping Fine, Steel, Copper, and Enameled Wires.

Spools are formed from black plate tested for maximum rigidity. Made with locked-seam barrel and one-piece ends, they are so assembled that there is no possibility of wire being trapped in the joint where barrel and end meet. Ends are made with full curl on edge, which provides additional strength and a smooth winding edge.



Entire spool may be finished with gold lacquer or a variety of colored lacquers; with or without identifying copy embossed in the ends.

Made in 2 7/16" and 3" diameter Ends. The 2 7/16" size is made with 1½" diameter Traverse only; the 3" diameter with 1½" or 1¾" diameter Traverse.

We will send samples at your request.

J. L. CLARK MANUFACTURING CO.
600 23rd AVENUE • ROCKFORD, ILLINOIS

has seen this New England manufacturing firm grow from an organization of a few hundred to one of more than 10,000 (wartime figure). The advertising department in 1908 consisted of himself and one stenographer, but today it is a sizable organization handling all of the company's trade paper and magazine copy, sales promotional material and two house organs; also maintaining its own photographic, exhibit and motion picture departments.

✦ ✦ ✦

MR. FRITTS was born on a farm in Warren County, New Jersey and his early education was obtained in the grammar and high schools of Washington, New Jersey.

✦ ✦ ✦

IN Worcester he has been active in many of the city's organizations. He was largely instrumental in the organization of the Advertising Club of Worcester in 1910 and served as its president in 1915 and 1916. He has been a member of the Worcester Rotary Club for 29 years, is a member of the United Commercial Travelers Association and an ex-president of the Worcester Commercial Travelers Association. He is a member of the Technical Advertising Association, Boston Chapter of N.I.A.A. He has served on the literature committee, two years as chairman, of the American Supply and Machinery Manufacturers Association.

B. W. HALL

✦ ✦ ✦

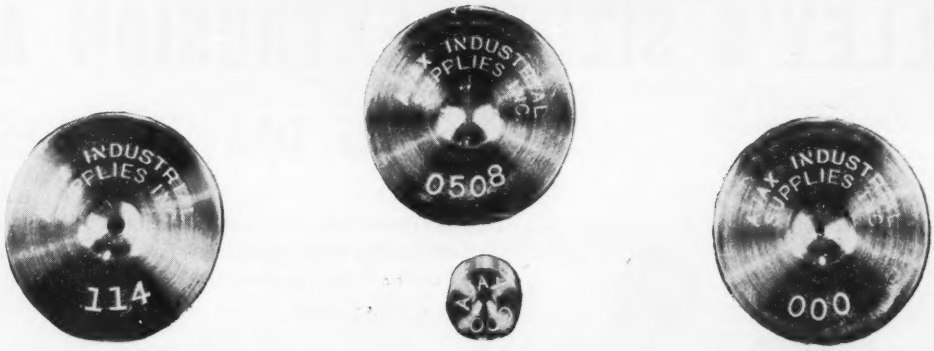
B. W. Hall, Sales Engineer, Hartley Wire Die Co.

HARTLEY Wire Die Company of Thomaston, Connecticut, manufacturers of high quality Tungsten Carbide dies, announce the appointment of **B. W. Hall** to supervise their new sales and sales engineering division.

✦ ✦ ✦

WHILE studying engineering at the University of Detroit and Lawrence Institute of Technology, Mr. Hall worked for Carboloy Company at Detroit in the Engineering and Drafting Department and as foreman of the die manufacturing department for six years. At the end of this period he was transferred to the Pittsburgh District as Service Engineer and Manager of the Pittsburgh Service Shop, spending much of his time during the ensuing six years in the various wire mills

(Please turn to page 811)



AJAX DIAMOND WIRE DRAWING DIES

and

DIAMOND POWDER

ARE MANUFACTURED TO YOUR SPECIFICATIONS
TAKE ADVANTAGE OF OUR SPECIAL ENGINEERING SERVICE

AJAX INDUSTRIAL SUPPLIES, INC.

BLUFFTON RD., P.O. BOX 66

FORT WAYNE, INDIANA

Telephone: Harrison 1311

A Review of Recent Wire Patents

No. 2,380,944, COLD ROLLED GRIP BOLT, patented August 7, 1945 by Edward J. Cole, Peekskill, N. Y., assignor to Cole Machinery Mfg. Corp., a corporation of New York.

✦ ✦ ✦

One or more thread convolutions is of greater diameter than the others, whereby the greater diameter convolutions form a slightly arcuate bulged portion in any desired zone of the threaded portion, the root line of the threaded bolt shank being a uniform helix lying on the surface of an imaginary cylinder.

✦ ✦ ✦

No. 2,381,003, INSULATED ELECTRIC CONDUCTOR, patented August 7, 1945 by Albert Olen Ryan, River Edge, N. J., assignor to Federal Telephone & Radio Corporation, New York, N. Y., a corporation of Delaware.

✦ ✦ ✦

About the wire conductor is a hollow, air-filled tubular insulating wrapper, disposed in a close lay, the turns having square or rectangular cross section and lying against each other to form a rigid support for the sheathing.

✦ ✦ ✦

Complete Descriptions and Drawings of Patents May Be Had for 25 cents; outside United States and Canada, $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

No. 2,381,124, COMPOSITION FOR CLEANING METAL SUCH AS ALUMINUM AND MAGNESIUM, patented August 7, 1945 by Joseph F. Hart, Los Angeles, Calif., assignor to Kelite Products, Inc., Los Angeles, Calif., a corporation of California.

✦ ✦ ✦

Comprises an aqueous solution containing sodium salts of orthophosphoric acid and silicic acid in substantially the stoichiometric proportions of three mols Na_2O per mol of P_2O_5 and one mol of Na_2O per two mols of SiO_2.

✦ ✦ ✦

No. 2,382,019, COMPOUND SCREW, patented August 14, 1945 by Edwin August Miller, Fairfield, Conn.

✦ ✦ ✦

A compound screw, having a lower shank portion of reduced diameter, is provided for driving into non-bored material.

✦ ✦ ✦

No. 2,382,081, METHOD OF TREATING WIRE FOR BELT MANUFACTURE, patented August 14, 1945 by Enrique L. Luaces and Melvin A. Crosby, Dayton, Ohio, assignors to The Dayton Rubber Manufacturing Company, Dayton, Ohio, a corporation of Ohio.

✦ ✦ ✦

More than one steel wire are passed through an acid surface roughening bath, dried, then passed through a solution of synthetic resin adapted to adhere to rubber. Thereafter the wires are cabled and the solvent evaporated from the coated cabled wires, whereby there is produced a unitary article comprising a plurality of wires formed into a cable and adhersively held to each other by the resin coating thereon.

✦ ✦ ✦

No. 2,382,275, INSULATED ELECTRIC CONDUCTOR, patented August 14, 1945 by Oswaldus Anthonius Jacobus van Lin, Venlo, and Johannes Hoekstra, Netherlands; vested in the Alien Property Custodian.

✦ ✦ ✦

Specifically, the invention resides in an insulating layer, about the assembled wire conductors, of mainly rubber hydrochloride and a second layer thereon, formed mainly of chlorinated rubber containing more than 60% by weight of chlorine.

WILLEY'S SIZING, EXTRUSION AND WIRE DRAWING DIES

Sales Engineers in Principal Cities.

They are made from a specially developed grade of Tungsten Carbide having those characteristics needed for dies—freedom from porosity, great abrasion resistance and the ability to take a polish equal to that of diamonds.

FOUR CLASSIFICATIONS OF WILLEY'S DIES

A. Blank and rough cored nibs.
B. Rough cored dies (cased).
C. Semi-finished, rough drilled dies (cased).
D. Finished dies, ready for use.

WRITE FOR NEW CATALOG 28

Gives full information on Willeys Dies in addition to other standard tools.

Standard Sizes from .325 to 4.000. Special Sizes and Shapes Made to Order.

WILLEY'S CARBIDE TOOL CO.
1340 W. Vernor Highway, Detroit, Michigan

No. 2,382,451, CORE WINDING APPARATUS, patented August 14, 1945 by Ladislav Stastney, Cicero, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

✦ ✦ ✦

A movable support is provided for the core and movable laterally of the core, being actuated to advance and then withdraw the support in timed relation to the approach and passing of the wire winding mechanism.

✦ ✦ ✦

No. 2,382,884, WIRE STRANDING MACHINE CREEL, patented August 14, 1945 by Howard E. Kuehn, Stonington, Conn., assignor, by mesne assignments, to Farrel-Birmingham Company, Incorporated, Ansonia, Conn., a corporation of Connecticut.

✦ ✦ ✦

This creel includes a hollow spindle through which the wire strand passes, an electric stop motion, a guide post about which the strand extends, and a pair of drums each rotatable and about which the strand extends a number of times after leaving the post and prior to entering the spindle, and a stop motion actuating device mounted on the post, maintained in inactive position by the strand engaging and passing about the post.

✦ ✦ ✦

No. 2,382,990, SPRING STRUCTURE, patented August 21, 1945 by Nathan C. Goldberg, New York, N. Y.

✦ ✦ ✦

The structure includes rows of helical coil springs, tension springs connected thereto and to strips of connecting metal, with cables extending between the rows of coil springs and also connected with the strips.

✦ ✦ ✦

No. 2,383,118, METHOD AND MEANS FOR DRAWING WIRES, patented August 21, 1945 by John T. Ferenci, Trenton, N. J.

✦ ✦ ✦

A method is provided which comprises pulling a wire of stock size in the direction of its length while gradually increasing pressure upon the wire until it reaches the desired drawn size, the value of the angle of the conical portion of the drawing die in degrees being equal numerically to the difference in diameters between the entrance and exit sizes of the stock, and then maintaining uniform pressure upon the wire during a length of its passage which is proportional to the difference between the stock and drawn sizes.

✦ ✦ ✦

No. 2,383,548, COATING COMPOSITION, patented August 28, 1945 by Charles B. Hemming, New Rochelle, N. Y., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

✦ ✦ ✦

For applying to wire conductors, this composition comprises (per centages being by weight) ethyl cellulose (ethoxyl content 43.5-44.5%—10.6, ethyl alcohol (denatured) 12.0, benzol 46.0, 60% solution in tuluene of 82% castor oil modified glycerol sebacate 21.4, butyl stearate 2.1, heavy mineral oil 1.7, nigrosine oleate 0.9, 60% solution in butyl alcohol of butyl alcohol modified urea-formaldehyde resin 5.3.

✦ ✦ ✦

No. 2,383,681, COMPOSITION AND PROCESS FOR CLEANING AND PICKLING FERROUS METALS, patented August 28, 1945 by Paul S. Pinkney and Halsey B. Stevenson, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

✦ ✦ ✦

The process comprises subjecting the metal to the action of a dilute non-oxidizing acid in the presence of a small amount of a thiazolinyl sulfide as an inhibitor, for controlling the corrosion of the metal by the acid.

✦ ✦ ✦

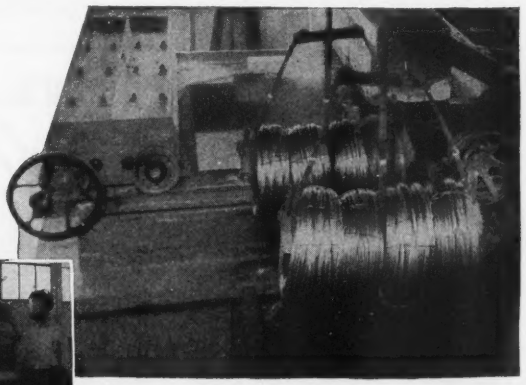
No. 2,383,800, METAL CLEANING COMPOSITION AND PROCESS, patented August 28, 1945, by Aaron D. Johnson, Brecksville, Ohio, assignor to E. I. du Point de Nemours & Company, Wilmington, Del., a corporation of Delaware.

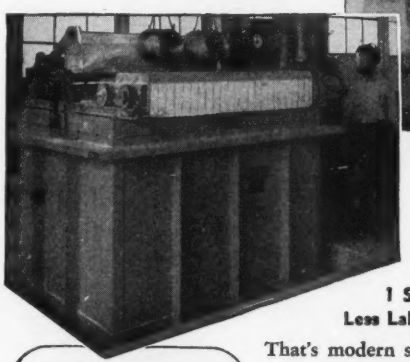
✦ ✦ ✦

This composition comprises about 10 to 90 parts by weight of 18° Be. hydrochloric acid, from 90 to 10 parts of a spent lactic acid obtained as the residue from the solvent extraction of a fermentation lactic acid, and from about 0.25 to 2.0 parts of oxalic acid.

(Please turn to page 822)

ANNEAL *Stainless** FASTER *in* SALT BATHS





Minutes . . . Instead of Hours!
1 Salt Bath . . . instead of 6 Conventional Furnaces!
Less Labor . . . Less Floor-Space . . . Less Cost!

That's modern salt bath heat treatment in a nutshell.

Specifically (referring to photos above): This well known producer increased his shipments of stainless steel wire 25% following installation of an Ajax Salt Bath Furnace for process annealing (1850° F.) and final annealing (1925°—1950° F.). Uniformly excellent results are achieved on 30 different alloy analyses and in all sizes down to 30 gage and less. Only 15 to 30 minutes immersion is required for the average charge. Production for 8 hours with the single Ajax furnace is equivalent to 24 hours operation of 6 atmosphere-type strand annealers previously used. Final cost per pound is substantially below previous cost.

It's the principle of the thing that makes this astounding difference . . . the Ajax principle. The bath is internally heated by closely-spaced electrodes which create an electromagnetic stirring action, thus holding temperature variations throughout the bath within 5° F. Faster heating cycles are made possible since heat is immediately transferred to the work by intimate contact thru immersion in the bath . . . conduction rather than radiation. And, as for atmosphere control . . . it's simple: salt baths control atmosphere by eliminating it! Further, the work is protected after removal from the bath by a thin film of salt which covers the surfaces. Ajax salt bath annealing of stainless steels adds up to these tangible advantages over conventional methods: Lower initial cost because less equipment is required; Lower production cost per pound of work annealed; Drastically less floor-space; Faster annealing cycles. Investigate modern salt bath heat treatment as applied by Ajax . . . batch type or completely conveyorized units can be supplied in any size to meet production requirements for all key heat treat processes in the temperature range of 300°—2400° F. Request Catalog 107C.

**Stainless*
WIRE
STAMPINGS
WELDMENTS
RODS
FORGINGS
CASTINGS
TUBES

A complete battery of production-type salt bath furnaces and the services of a competent metallurgical staff are available for heat treating specimen work. No obligations entailed.

AJAX ELECTRIC COMPANY, INC.
FRANKFORD AVENUE AT DELAWARE AVENUE, PHILADELPHIA 23, PA.
In Canada: Canadian General Electric Co., Ltd., Toronto, Ont.

THE AJAX HULTGREN ELECTRIC SALT BATH FURNACE

ASSOCIATE COMPANIES
Ajax Metal Company ● Ajax Electric Furnace Corporation ● Ajax Engineering Corporation ● Ajax Electrothermic Corporation

GOVERNMENT WIRE PRODUCTION INFORMATION

The following is a message from General Brehon Somervell, Commanding General of the Army Service Forces, to war workers over the nation on the occasion of V-J Day.

To America's War Workers In Industry

"ON this first day of peace, I extend the thanks of the Army Service Forces to you men and women—labor and management alike—who performed miracle upon miracle to supply our fighting forces the world over with the weapons so necessary to crush a mighty and ruthless enemy. Without you, without the food and clothing, guns and munitions, planes and tanks and all the other myriad items of war you produced, your sons and brothers, fathers and husbands, would have faced the enemy in vain.

"WITHOUT your loyalty, your skill, your muscles, and your brains, without your unselfish devotion to our common cause, we never would have been able to furnish the tools of glorious victory. You planners and workers in all our industries have contributed heroically. There are many heroes among you, just as there have been heroes in the thick of bursting shells at the battle fronts. I know that I speak for every member of the armed forces when I say to you, "God bless you."

✦ ✦ ✦

Future Army Contracts To Be Awarded On Competitive Price Basis

EFFECTIVE immediately greater reliance will be placed upon competitive prices in the awarding of Army contracts, the War Department has announced. This is a departure from the wartime practice of letting contracts on a strictly negotiated basis. The change has been made possible because of the tremendous drop in Army procurement, the relaxation of delivery schedules and the consequent increase in competition for the business.

✦ ✦ ✦

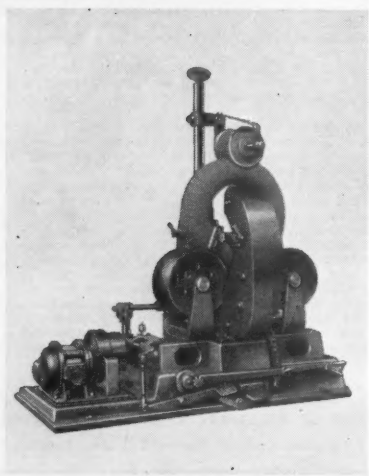
WHERE there is competition for War Department procurement, the chief of the technical service involved will advertise and solicit quotations. All requests submitted to contractors will state that while the award of a particular contract will normally be made to the lowest qualified bidder, the War Department reserves the right to award the contract as the result of negotiation and to reject any or all bids.

✦ ✦ ✦

IF the price is fair and reasonable and the bids received indicate the effect of competition, the award will be made to the low bidder and no detailed analysis of estimated cost will be needed. No further negotiation will be necessary under such conditions. However, if no real competition is reflected in the bids, if

IS YOUR COIL WRAPPING A *Problem?*

If so, Angier of Framingham probably has the answer, having developed, over a long period of years, crinkled protective wraps for all kinds of wire and strip steel and the spiral wrapping machines to apply them.



Illustrated is one of several Angier machines, all of which are engineered for quick adjustment and easy control. Others, together with the right wraps for various types of coils, are fully described in our new booklet, *"The Better Way to Wrap Coils."* . . . Ask for it.

ANGIER CORPORATION

• CORROSION PREVENTIVE AND WATERPROOF PAPERS •

FRAMINGHAM, MASSACHUSETTS

an insufficient number of contractors submit bids, or if prices bid are excessive as compared with earlier prices, an analysis will be necessary and negotiation will continue. This practice will also be followed if Army procurement requirements absorb a substantial portion of the capacity of an industry or if requirements are placed with a sole source, as in research and development contracts. If bid prices indicate that the contractors are deliberately pricing themselves out of government business in order to handle civilian business, the same procedure will be followed.

✦ ✦ ✦

ALL contracts, except those relating to civil projects under the Chief of Engineers, will be awarded under the First War Powers Act and Executive Order No. 9001, and the Act of 2 July 1940, as continued in effect by the Act of 5 June 1942.

✦ ✦ ✦

Tin Controls

TIN controls must be continued until a sufficient reconversion supply is obtained from the Malayan Peninsula and adjacent territory, the world's principal tin source, War Production Board officials informed members of the Tin Plate Industry Advisory committee at a recent meeting.

✦ ✦ ✦

Officials of the Tin-Lead-Zinc Division disclosed that they had already requested the military authorities to furnish all available information at the earliest possible moment on the condition of the tin mines in the Far East and available pig tin stockpiles in that area.

✦ ✦ ✦

TIN mill products requirements principally tin plate in the fourth quarter will be approximately 840,000 tons minimum compared with 933,000 tons in the third quarter. The fourth quarter figures included 575,000 tons for food containers; 20,000 tons for bottle caps; 25,000 tons for other types of closures; 6,500 tons for home canning; 40,000 tons for Canada; 95,000 tons for lend-lease and about 70,000 tons for all other uses.

THE recently announced cutbacks in naval shipbuilding programs may reduce bronze requirements, which in turn will cut the demand for tin for new construction, but much bronze will still be needed for maintenance repairs and operating supplies.

✦ ✦ ✦

WPB officials expressed some concern over an increase in tin consumption in 1945 over 1944. They pointed out that tin consumption amounted to 47,000 long tons in the first six months of 1945 or at an annual rate of 94,000 long tons, compared with tin consumption of 90,000 long tons in 1944.

✦ ✦ ✦

Carbide Tool Training Films Available

THE U. S. Office of Education has just released five new training films (16 mm. Sound motion pictures) supplemented by 35 mm. slide film "strips" for discussion-review, on the following subjects:

Film #241—Brazing Carbide Tools.

(Please turn to page 808)

Experience of many mills indicates that where soap-base lubricants are used in wet-drawing brass, bronze and copper and where wire is pickled after annealing, the soap has a tendency to break down. Often a green scum develops on wire.

This trouble is largely due and can be frequently traced to incomplete removal of acid used in pickling operation. Rinsing apparently does not entirely correct the condition because the lubricant in wet drawing machines will usually show wide variations in pH.

However, a successful answer to this trouble in drawing brass, bronze and copper wire has been found by many mills. They use

Oakite Composition No. 29

By immersing wire in a hot solution of this material, acid is effectively neutralized after pickling. Doing this provides several advantages. You get greater life of the soap lubricants. Formation of green scum is controlled and inhibited. Wire holds bright. Production time is gained.

Wire mill superintendents and foremen desiring to make tests of Oakite Composition No. 29 for neutralizing, may obtain further details from the Oakite Technical Service Representative in their locality . . . or write us direct. There is no obligation.

OAKITE PRODUCTS, INC., 52A Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE MATERIALS METHODS SERVICE — Buy Bonds for Victory — **CLEANING** FOR EVERY CLEANING REQUIREMENT

Government Wire Production Information

(Continued from page 807)

Film #242—Grinding Single Point Carbide Tools.

Film #243 — Grinding Multiple-point Carbide Tools (Milling Cutters).

Film #244 — Cutting with Carbide Tools *Single Point.

Film #245—Cutting with Carbide Tools *Milling Cutters.

✦ ✦ ✦

THESE have been prepared under the supervision of the U.S.O.E. with the technical assistance of Carboloy Company, Inc., and other manufacturers. The facilities of the Carboloy plant were made available for the actual filming of these pictures.

✦ ✦ ✦

THE films give step-by-step procedure in brazing, application and grinding of carbide tools based upon the latest techniques recommended by carbide manufacturers. They will be of value in training new men as well as an excellent "refresher" course for skilled workers and supervision.

✦ ✦ ✦

A FAR CRY SINCE THE 14TH CENTURY

Wire was originally made by beating the metal out into plates, which were then cut into continuous strips, and afterwards rounded by beating.

BUT WIRE TODAY IS ONLY AS DEPENDABLE AS ITS MAKER

At Wickwire Brothers Mills in Cortland we begin by making our own steel.

We draw the wire to rigid specifications on modern machines. Many of our own special processes are used—you get over 70 years of knowledge and experience built into our products.

WIRE, plain, galvanized, coppered, tinned, in coils, on spools or straightened and cut to length—in all sizes.

WICKWIRE BROS., INC.

CORTLAND, N. Y.

SPECIFY CORTLAND BRAND WIRE

THESE films (and films strips) are being made available through Castle Films, RCA Bldg, New York City, who have been appointed official distributors by the U. S. Office of Education.

✦ ✦ ✦

Wire Laying by Projectile

TROOPS in combat areas can now **shoot** assault wire — at a speed of 180 miles per hour — by means of bazookas and rifle grenades, across rivers, swamps, ravines and other types of impassable terrain. The wire is payed out at this high velocity from coils recently developed by the Signal Corps.

✦ ✦ ✦

Sgt. Horace V. Hiatt, La Porte, Ind., and S/Sgt. John W. Andrews, right, Gunnison, Colorado, adjust wiring on Bazooka Projectile with wire, W-130, attached to Field Wire W-110. When the makeshift Bazooka is fired, the Projectile pulls W-130 Wire over ditches, rivers, or other obstacles, and the field wire is pulled the rest of the way by hand. 5th Sig. Co., 5th Inf. Div., Mersch, Luxembourg. ✦ ✦ ✦ ✦

WHEN bazookas are used, it has been found that the initial velocity of the rockets is about 180 miles per hour, yet the insulation on the wire is not damaged and the tensile strength of the conductors is satisfactory. Rivers and ponds 200 yards in width are successfully spanned by this means.

✦ ✦ ✦

WHEN a bazooka is used the wire coil is placed about six feet in front of the bazooka muzzle. The payout end of the coil is formed into a slip loop and taped to the muzzle of the bazooka. When fired, the rocket, passing through the muzzle of the bazooka, engages the slip loop. Wire payout continues until the rocket speed is expended.

Wire W-110B actually being projected by Rifle Grenade M11A2.

✦ ✦ ✦ ✦

WHEN rifle grenades are used to shoot wire they are launched by means of M-1 rifles. The wire is payed out merely by attaching the payout end to the grenade and then firing. Wire can thus be laid over bodies of water or other obstructions 200 feet wide. Circuits installed may be connected to field telephones and communication quickly and satisfactorily established.

✦ ✦ ✦

THE possibilities of the use of communication wire prepared in the coil form mentioned is considered almost unlimited, and it is believed that many other methods of employment will ultimately be discovered and worked out by field units.

✦ ✦ ✦

Stainless Steel Cleveland Basing Point Announced By American Steel & Wire Co.

American Steel & Wire Co. today announced effective immediately it has established a basing point at Cleveland, Ohio, to apply to all sales of U. S. S. stainless steel produced by this company in the Cleveland area. Prior to today's announcement these products were sold on a Pittsburgh base.

✦ ✦ ✦

THIS new basing point is applicable to U. S. S. stainless steel cold drawn wire, cold rolled flat wire, cold finished bars, and cold rolled strip within the range of sizes and finishes produced by American Steel & Wire Co. in the Cleveland area. All prices are subject to OPA price ceilings.

✦ ✦ ✦

Issues Book On Quality Control

Federal Products Corporation, 1144 Eddy Street, Providence, R. I., has published and is offering to any concern interested in quality control method a 24-page book entitled: **"Federal Statistical Quality Control Primer."** With it are furnished two forms: **Shop Analysis Chart** and a **Work Sheet.** These are mentioned because no such charts have been heretofore available, most plants having had to work out their own. Extra copies of these may be secured at a nominal charge. The book and charts offer a practical approach to the handling of a difficult subject and it is hoped that many of our readers will find the book and charts of value and interest.

✦ ✦ ✦

Buffalo Bolt Acquires Eclipse Lawn Mower Co.

IN its second expansion within a year, the Buffalo Bolt Company, manufacturers of bolt sand nuts, has acquired, for cash and stock, the entire outstanding capitalization of The Eclipse Lawn Mower Co., of Prophetstown, Ill., manufacturers of hand and powerdriven lawn mowers.

Warner

BELL-MINE LIME
for
WIRE DRAWING

Warner COMPANY
BELLEFONTE DIVISION
BELLEFONTE, PA.

Sales Offices

PHILADELPHIA PITTSBURGH NEW YORK

Cleaning and De-Whiskering Nails

(Continued from page 734)

THIS second drum is equipped with a hood and plate gas burners impinging on the outside of the shell. This supplies sufficient heat to warm the sawdust and aids in drying the nails.

✦ ✦ ✦

IT is only necessary to replace the sawdust which becomes disintegrated through continued use. For this reason, the second drum may be charged with cob-meal which, while more expensive, is more absorbent and has a better polishing action than the average run of sawdust.

✦ ✦ ✦

THIS second drum is equipped with a patented discharge head, similar to that in the first drum, which permits its automatic emptying by simply reversing the direction of rotation. When the nails are polished the drum is reversed and the nails and sawdust are emptied from the drum and onto a vibrating pan.

✦ ✦ ✦

THE sawdust and nails still mixed move down this pan and drop over an open step. As the nails and sawdust cross this step, the sawdust is sucked up into an exhauster and returned through a cyclone separator to the sawdust barrel. The nails continue onto the keg shaking pan, and are dropped into the kegs, ready for weighing and heading.

✦ ✦ ✦

NAILS that are to be cement coated are by-passed after sawdust separation onto a conveyor which carries them to the cement coating drum. This drum is the same general design as the other two drums and is discharged by reversing the direction of rotation. The cement is added to the batch through a slotted pipe extending the full length of the tumbling compartment and the batch tumbled until the lacquer is dry. The cement coating drum is located so that it discharges directly on to the keg shaking pan feeding the keg shakers.

✦ ✦ ✦

IT will be evident to the readers that this new and improved method of cleaning and de-whiskering nails provides three major improvements over the traditional methods: labor costs are reduced, the finished product improved, and the entire operation speeded up.

✦ ✦ ✦

INDIANA
DIAMOND WIRE DRAWING DIES

are now being made in the new and finer quarters, to which the steady growth of our business required us to move on September 1, 1945.

We take this opportunity to thank our many customers for their loyalty and patronage, and to assure them that no effort will be spared to maintain the name "INDIANA" as a synonym for quality in diamond dies.

Your inquiries regarding our dies and refinishing service will be welcomed.

Please address the

INDIANA WIRE DIE COMPANY
314-324 East Wallace Street
FORT WAYNE, INDIANA
Telephone: Harrison 4373

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues Are $10.00 AND INCLUDE

1. A subscription for the period of the membership to the designated official publication of the Association, "WIRE AND WIRE PRODUCTS."
2. A copy of the annual WIRE BUYERS GUIDE AND YEAR BOOK OF THE WIRE ASSOCIATION.
3. A copy of the proceedings and discussions held at the annual meeting.
4. Co-operative and helpful information on processes and methods of production.

For Details Address

Richard E. Brown, Secretary,
The Wire Association

Outstanding Personalities of the Wire Industry

(Continued from page 803)

throughout the country, setting up die rooms and instructing personnel in the finishing and use of drawing dies.

✦ ✦ ✦

FOR the past three years, as sales representative, he has promoted the use of Tungsten Carbide dies throughout the New England territory. He is an active member of the Wire Association and is thoroughly acquainted with all types of dies and their application.

✦ ✦ ✦

T. H. Chamberlain
Factory Manager
Waterbury Mfg. Co.

THOMAS H. CHAMBERLAIN has been appointed factory manager of the Waterbury Manufacturing Company plant of the Chase Brass & Copper Company, according to an announcement recently by President Charles E. Hart. Mr. Chamberlain, who was made assistant factory manager last year, has been in charge of operations at the Waterbury Manufacturing Company since the transfer of former manager, Wallace C. Husted to the company's Cleveland mill last July.

✦ ✦ ✦

MR. Chamberlain came to the Waterbury Manufacturing Company to be superintendent of finishing in November, 1938, after 15 years with the New Haven Clock Company as head of their research laboratory. In 1942 when the production of shell and cartridge cases was at its most critical stage, he became superintendent of the cartridge case department of the Waterbury Manufacturing Company plant and his promotion to assistant factory manager was announced in July, 1944.

✦ ✦ ✦

H. M. Francis
Ass't Vice President
American Steel and Wire Corp.

HARRY M. FRANCIS has returned to the American Steel & Wire Company, U. S. Steel subsidiary, where he will shortly resume his duties as assistant vice president, sales, following a three-year period of service with the War Production Board in Washington.

✦ ✦ ✦

MR. FRANCIS entered Government service in May, 1942, as chief of the Wire and Rod Branch of the Steel Division of W.P.B. At the time of his departure, he was deputy director of the Steel Division.

✦ ✦ ✦

MR. FRANCIS first started working for American Steel & Wire in 1915 and served in various sales capacities in Philadelphia, New York, Boston and Cleveland, before being appointed assistant vice president in December, 1938.

✦ ✦ ✦

Our advertising pages — have you studied them carefully? They contain information to guide you in the successful operation of your business. And when you write an advertiser for prices, catalogs or detailed data, won't you please say you saw his ad in WIRE AND WIRE PRODUCTS.

USE . . . . .

WIRE and WIRE PRODUCTS

– A Good Advertising Medium –

When you plan your advertising for 1946, if you sell machinery, equipment, supplies or wire to our industry—to the concerns making wire or to those who fabricate wire products, it will pay you to include WIRE AND WIRE PRODUCTS in your new advertising schedules.

Wire and Wire Products goes to the production executives of the industry, and these are the men that must be "sold" if your products are to be used in their mills.

Your advertising story in Wire and Wire Products reaches these men in an editorial atmosphere related to their own problems and reaches them with a maximum of efficiency.

So back up your salesmen and direct mail efforts by taking appropriate space in Wire and Wire Products. For rates and other data, please address:

WIRE and WIRE PRODUCTS

300 MAIN STREET • STAMFORD, CONN.

Edmund D. Sickels, Advertising Manager

NILSON

AUTOMATIC PRESS
and
FOUR SLIDE MACHINE

FOR SWAGING, STAMPING, PIERCING, BLANKING,
FORMING OF COILED METAL

WE also build machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc., and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.

For Complete Details Address—

THE A. H. NILSON MACHINE CO.

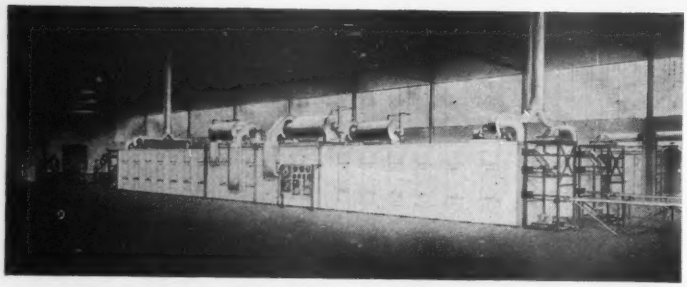
BRIDGEPORT, CONN., U. S. A.

MORE PRODUCTION
IN LESS TIME *with*

CARL-MAYER HI-SPEED
ROD BAKER

The fastest rod baker built! Saves up to 50% in time and fuel. Patented Blow-Off Feature removes moisture without bumping or agitating the coils. **Patented and patents pending.**

CARL-MAYER
FURNACES, OVENS



WELDING ROD OVEN

For drying coated welding rods. Uses the "Mayer" Recirculating Gas Fired Air Heater principle and Rod Transfer Systems (patents pending).

Growing interest in our type of equipment is evidenced by Carl-Mayer installations in such plants as:—

Atlantic Wire Co.	Hollup Corp.	Pittsburgh Tool Steel Wire Co.
Atlas Tack Corp.	Johnson & Nephew Ltd.	Steel Co. of Canada
Atlas Steel Co.	Page Steel & Wire Co.	Wickwire Spencer Steel Co.
Eaton Mfg. Co.	WRITE for BULLETIN No. 241	

THE CARL-MAYER CORPORATION 3030 EUCLID AVENUE CLEVELAND, OHIO

Steel Industry To Be Large Aluminum Buyer

THE competitive steel industry will become one of the principal consumers of aluminum in the postwar world, perhaps expanding its consumption as much as ten times its prewar average, **Roy A. Hunt,** president of Aluminum Company of America, asserted recently.

✦ ✦ ✦

ALCOA believes it possible that within the next five years, the United States market as a whole will be consuming 1,250,000,000 pounds of aluminum a year, or some five times the prewar average, he said in a radio address broadcast by the Mutual Broadcasting System. "If this proves to be the case, the aluminum industry could give employment to about 100,000 people," he added, comparing this figure to the prewar level of about 33,000.

✦ ✦ ✦

THE steel industry will use aluminum as a de-oxidizing agent in the production of steel, as a coating for thin sheets of steel, and as a covering of steel sheet to produce plymetals, Mr. Hunt said.

✦ ✦ ✦

Rustless Issues New Handbook On Machining Stainless Steels

ADDING another important volume to its "Library of Stainless Steel Information," **The Rustless Iron and Steel Corporation** has just released an 84-page reference booklet on the subject, "Machining of Stainless Steels."

✦ ✦ ✦

THE purpose of this new volume as well as of the entire series is to make available to the metal trades the most up-to-the-minute information on the fabrication and application of the various grades of stainless steels. The data is prepared from actual production experience and laboratory research by Rustless' staff of field engineers and research metallurgists.

✦ ✦ ✦

COPIES of this thumb indexed and wire-bound book, containing a ready-reference store of valuable information for machinists and

estimating engineers, can be obtained by writing to the Rustless Iron and Steel Corporation, Baltimore, 13, Maryland.

✦ ✦ ✦

Ross Issues New Catalog

A NEW Catalog, No. 131, just issued by the **J. O. Ross Engineering Corporation,** is unusually complete in the helpful information it provides.

✦ ✦ ✦

IT devotes a large section to the principles and processes of industrial drying and describes methods employed in a variety of industries and treats also such subjects as Infra Red Drying; Sources of Heat and Heat Cost, Comparisons, Material Handling, Oven Construction and Temperature Control.

✦ ✦ ✦

COPIES of Catalog No. 131 may be had by writing to the J. O. Ross Engineering Corporation at 350 Madison Avenue, New York 17, New York, or to any of its branch offices in Boston, Chicago, Detroit and Los Angeles.

✦ ✦ ✦

Booklet Containing San Francisco Charter Offered

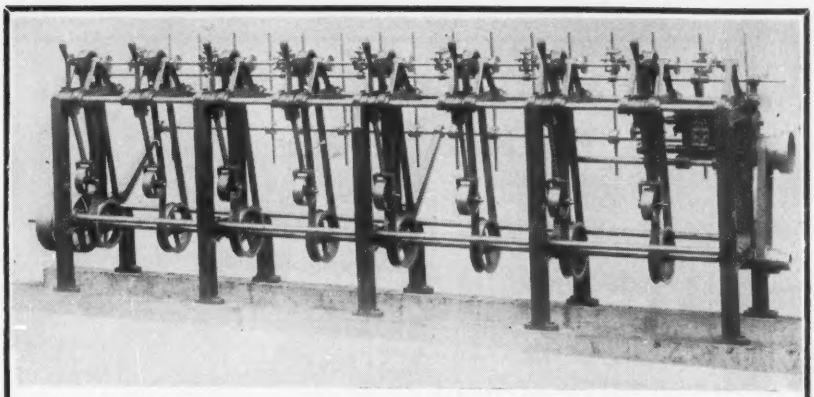
BUSINESS men who have not familiarized themselves with the San Francisco Charter will welcome the handy pocket size booklet containing the Charter's complete text, sponsored by **George Spatta,** president of Clark Equipment Company, Buchanan, Michigan.

"American industry has a vital interest in international policies," states Mr. Spatta; "and a knowledge of our nation's commitments in the field of international affairs is essential to an understanding of the effects of foreign policy upon our national economy."

✦ ✦ ✦

IN addition to the Charter text, the booklet lists those nations which have already ratified the Charter, and provides space for recording approval by other nations. Any executive desiring a copy of the booklet may obtain it by writing on a business letterhead.

✦ ✦ ✦



No. 1900E SPOOLER

WIRE SPOOLING MACHINES

Model illustrated takes spools up to 12" diameter. Floor space required: 19" x 10'; length can be varied to suit largest spool specified. Handles wire up to .050" diameter. Other models made to suit specific requirements.

EMORY SPOOLERS are built for years of continuous service. Precision made, durable, rugged, dependable.

BUILDERS OF WIRE SPOOLING MACHINERY for A HALF CENTURY

For details, write to

ROBERT J. EMORY COMPANY

31 East Runyon Street

NEWARK 5, N. J.

Telephone Bigelow 3-4415

New Incentives

speed production NOW!

and PRODUCTIMETERS

will help you maintain accurate production control as you start work on that tremendous backlog for post-war needs. Throughout various wire processing, Productimeters give exact measurement in feet or yards . . . provide records for time study and control. They're ruggedly built, precision designed to meet heavy production demands.

You'll find the Productimeter line of wire measuring units complete, offering models of varying speeds and capacities.

Model 5-SD-7-3 End Drive Rotary Productimeter installed on Wardwell 16-carrier Braider

Note flexible coupling connection to capstan. Registering directly in feet, the unit furnishes records for establishing fixed costs per foot of braiding.

Ask for Catalog No. 3

DURANT MANUFACTURING COMPANY

1918 N. Buffum St., Milwaukee 1, Wis. 118 Orange St., Providence 3, R. I.

PRODUCTIMETERS
THE SPEEDOMETERS OF INDUSTRY

TUNGSTEN CARBIDE DIES
for HEADING and
WIRE AND TUBE DRAWING (.030" to 2"),
EXTRUSION (1/16" to 1"), RECUTTING AND
WELDING ELECTRODE COATING.

RING GAUGES
DIAMOND DIES (.0015" up)
DIAMOND POWDER IN ALL GRADES

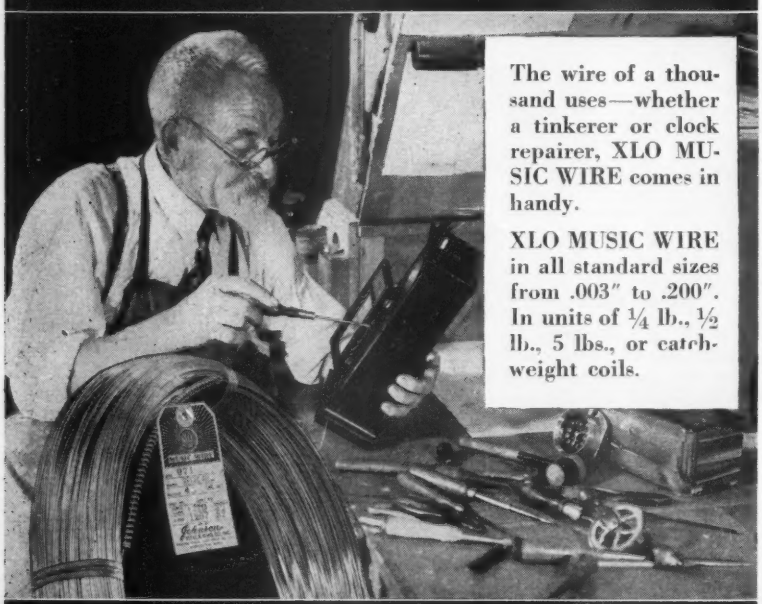
AIRCRAFT EXTRUSION DIES

As a special service to customers, we are prepared to give three day service on standard wire, tube and extrusion dies in cases of extreme urgency.

Address Inquiries to

MICHIGAN WIRE DIE CO.
11152 Chalmers Avenue
Telephone:
PINGREE 5702
DETROIT 5, MICH.

JOHNSON *Wire*



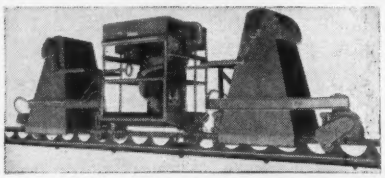
The wire of a thousand uses—whether a tinkerer or clock repairer, XLO MUSIC WIRE comes in handy.

XLO MUSIC WIRE in all standard sizes from .003" to .200". In units of ¼ lb., ½ lb., 5 lbs., or catch-weight coils.

JOHNSON STEEL & WIRE CO., INC.
WORCESTER 1, MASSACHUSETTS
NEW YORK AKRON CHICAGO LOS ANGELES

Develops New Double Bucket Carrier

A NEW motor-driven cab-operated double bucket carrier has been developed by **The Cleveland Crane & Engineering Co.**, Wickliffe, Ohio, for the transportation of dry bulk materials.



THE operation of the carrier and the opening and closing of the bucket gates are handled by the cab operator who sits on swivel chair enabling him to work in the direction of either bucket. A single variable speed drum controller is located on one side of the cab, but two foot brakes are provided, one at either end so that one is always in convenient reach of the operator regardless of which direction he is operating the carrier. Push-pull levers for opening the bucket gates extend into the cab and permit emptying the materials in any amounts and at any rate desired.

✦ ✦ ✦

THE unit illustrated has two 25 cu. ft. buckets and is designed for carrying a total load of two tons. Other size Cleveland Tramrail carriers can be supplied, however. The buckets are designed and located with reference to the tramrail arch beam rail, so that they may be easily filled from overhead bins without interference or spillage. The carrier is provided with two motorized travel drives, one at each end, and operates at speeds up to 600 feet per minute.

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THE WIRE ASSOCIATION TECHNICAL SESSIONS AND INFORMAL MEETINGS ADMISSION WILL BE BY BADGE ONLY

Booklet Describes Spectrometer

A NEW 12-page booklet titled **"Engineering-Design Development of X-Ray Spectrometer"** has been announced by North American Philips Company, Inc., 100 East 42nd Street, New York.

✦ ✦ ✦

THE text material was written by Mr. J. S. Buhler, Technical-Commercial Manager, and covers in detail the basic design principles involved in the Geiger-Counter X-ray Spectrometer, designed to check composition of materials.

✦ ✦ ✦

SPECIFICALLY, the author discusses: X-ray diffraction principals, new instrument requirements, X-ray source, pulse conditioning, frequency meter circuit, counting meter circuit, meters and controls, and applications. Amply illustrated with drawings and photos, the new booklet should be a valuable addition to the industrialist's library.

✦ ✦ ✦

Board containing carefully-placed pins to accurately shape connection wires for NORELCO industrial X-ray units at the Mount Vernon, N. Y. plant of North American Philips Company, Inc. Looking very much like the "works" of a home radio set, this particular assembly is the power supply for the control of a Geiger-Muller tube. War has greatly accentuated the demand for such X-ray equipment. ✦ ✦ ✦ ✦

Our ADVERTISING PAGES are reliable sources of supply. ADVERTISERS are good people with whom to do business. They advertise to help you. Buy from them to assure yourself of the best that responsible concerns can make. An ADVERTISER likes to know his ads have been read, so please mention WIRE & WIRE PRODUCTS when writing him.

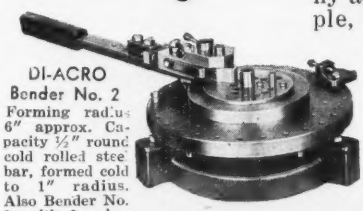
The DI-ACRO Bender makes perfectly centered eyes from rod or strip stock at high hourly production rates. Both eyes and centering bend are formed with one operation. Any size eye may be formed within capacity of bender and ductile limits of material.

Precision CENTERED EYE *Bending*

With DI-ACRO Benders

DI-ACRO Precision Bending is accurate to .001" for duplicated parts. DI-ACRO Benders bend angle, channel, rod, tubing, wire, moulding, strip stock, etc. Machines are easily adjustable for simple, compound and reverse bends of varying radii.

DI-ACRO Bender No. 1
Forming radius 2" approx. Capacity 7/32" round cold rolled steel bar or rolled steel bar or equivalent.



DI-ACRO Bender No. 2
Forming radius 6" approx. Capacity ½" round cold rolled steel bar, formed cold to 1" radius. Also Bender No. 3, with forming radius 9" approx.

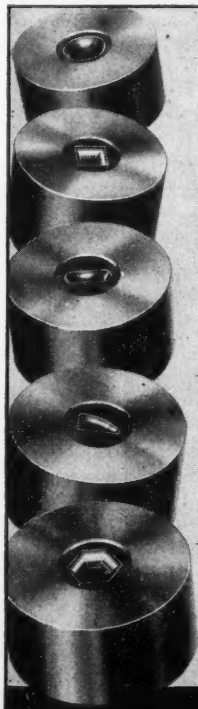
Send for CATALOG "DIE-LESS" DUPLICATING showing many kinds of "die-less" duplicating produced with DI-ACRO Benders, Brakes and Shears.

DI-ACRO is Pronounced "DIE-ACK-RO"

DI-ACRO PRECISION MACHINES DIE-LESS DUPLICATING

O'NEIL-IRWIN MFG. CO.

303 EIGHTH AVE. SOUTH • MINNEAPOLIS 15, MINN.



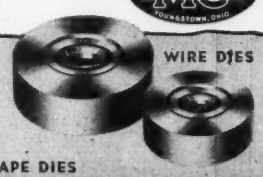
Super-hard . . . TALIDE DIES

. . . . are producing more and more tonnage records in drawing and extruding wire, rods, bolts, rivets and tubing.

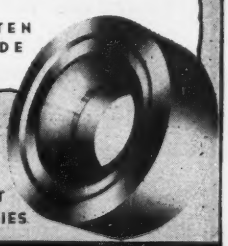
The extra hardness, density and toughness of Talide Nibs insures smoother draws and finer finishes. Enjoy trouble-free, continuous production with the elimination of scoring, galling and frequent die changes.

Talide Dies are available in a wide range of sizes from .010" I. D. Wire Dies to 24" I. D. Sheet Metal Dies —made by the Hot Press Method pioneered and developed by us. Send for catalog 43-WP listing full particulars and prices.

TIPPED WITH TALIDE TUNGSTEN CARBIDE



WIRE DIES



SHAPE DIES

SHEET METAL DIES

METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO

TUNGSTEN CARBIDE TOOLS . DIES . WEAR PARTS

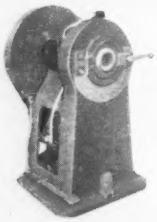
OLD AS THE HILLS

STILL THE BEST WAY

Hammering is the time-proven method of forming or sizing metals. Through the ages men have hammered their tools and weapons, improving the structure without wasting the metal.

"Standard"

SWAGING MACHINES



"Standard" Swaging Machines bring hammering methods up to date . . . providing 4500 blows per minute and using dies that form identical reductions of the pieces. Unskilled operators deliver smoothly finished work to exact specifications on a production basis.

Write for Catalog

STANDARD MACHINERY COMPANY

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Rustless Announces Building Program of Five Projects To Cost $2,440,000

CONTINUING a program of expansion which was interrupted by outbreak of the war in 1941, the **Rustless Iron and Steel Corporation** has announced a series of five building projects to cost approximately $2,440,000, and which will put the company in position to meet the demand arising from new products developed and progress gained through use of stainless steels during the war years.

✦ ✦ ✦

THE largest unit in the expansion program at Rustless is a new Rod Mill for hot rolling of wire coils down to smaller sizes than can be produced by present facilities. The appropriation for this new mill, which involves relocation of the present Rustless Rod Mill for rolling wire coils, is $1,370,000.

✦ ✦ ✦

THE Rod Mill will be a 28-bay building, 560 feet long, beginning at the present grinding Annex which is adjacent to the Rustless North Plant.

✦ ✦ ✦

CHIEF benefit to be gained from the new Rod Mill will be greater flexibility in production and processing of stainless steel wire, making possible the production of heavier weight coils of rods in a variety of sizes and increasing the rolled tonnage capacity.

✦ ✦ ✦

DuPont To Expand Plastics Production Facilities

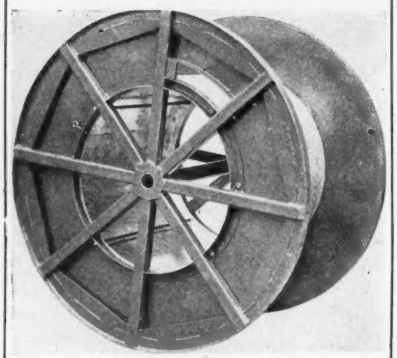
THE **E. I. duPont de Nemours and Company** has announced that the company is exercising options to purchase a site of about 400 acres at Washington, near Parkersburg, W. Va., to provide plant space on which to expand the company's activities in the plastics field.

✦ ✦ ✦

THE duPont Company already operates one of the largest plastics plants in the country located on a sixty-four acre site at Arlington, N. J., and a smaller plant at Leominster, Mass. Neither of these locations provides sufficient space to accom-

ALL STEEL REELS

FOR SHIPPING
FOR STORING
CABLE AND WIRE



Last Longer

Constructed of corrosion resisting materials, three to four times the life of a wooden reel is a reasonable expectancy.

Give Greater Protection

Smooth inner surfaces, much greater strength with the absence of all cutting or abrading projections — these protect not only the cable but the men handling it.

Save On Freight

Appreciably lighter than wooden reels — cost less to ship — a cumulative saving that more than offsets increased first cost.

Reduce Investment

The longer life of R. B. Hayward Steel reels reduces the investment in reel equipment.

Write for description of construction and prices.

R. B. HAYWARD CO.

1714 Sheffield Ave.

Chicago, Illinois

modate the expansion in manufacturing facilities which it is now forecast will be required over the next several years.

✦ ✦ ✦

POLYTHENE, one of the new plastics being developed by the Du Pont Company, is now used extensively in the electrical insulation field and possesses outstanding advantages which should give it an important position in the plastics field generally. Adequate facilities to supply this plastic will be provided.

✦ ✦ ✦

Allegheny Ludlum Steel Corp. Announces Plant Expansion

A $5,000,000 postwar research and production expansion program has been approved by the Board of Directors of the **Allegheny Ludlum Steel Corporation,** President Hiland G. Batcheller announced recently.

✦ ✦ ✦

AN ultra-modern research laboratory and related experimental and pilot plant equipment will be built at company headquarters, Brackenridge, Pa., to intensify studies of the structure, melting, processing and further development of high alloy steels.

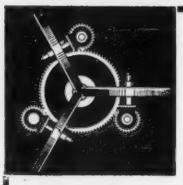
✦ ✦ ✦

AT the West Leechburg, Pa. plant will be constructed a cold rolling mill of latest design, for rolling stainless and silicon strip steels. It will add materially to the capacity of the plant and will bring new precision and uniformity of quality in the production of the special strip steels made there.

✦ ✦ ✦

Wire and Cable Company Gets "E" Award

THE nation's highest award for excellence in the production of war materials — the Army and Navy E — was presented to the **Plastic Wire & Cable Corporation,** Norwich, Connecticut late in June. In his address, Capt. William A. Wood, Chief of Technical Information, Signal Photo Centre, Astoria, N. Y., characterized the corporation's record of producing wire just sixty-nine days after its formation as "nothing short of amazing."



WIRE MEASURING MACHINE
FOR LINEAR MEASURE
PROVIDES NEW STANDARD OF ACCURACY

Illustration Shows Exclusive Patented "3V" Principle

Measuring twisted, armored, bare or insulated wire without vibration or inaccuracies at any speed or varying speeds!

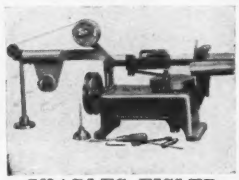
97 Belmont Street, BROCKTON, Massachusetts
LYON-VAIL MACHINE CO., INC.
Write for Information and Prices

WIRE CUTTING and SHAPING MACHINES, FINE WIRE WELDERS
We make Spot Welders from ¼ to 500 KVA & all Types Butt Welders

Automatic Drawing and Cutting Mach.

Eisler fine wire cutting and forming machines have been in use over twenty-five years.

Wire Cutting & Annealing Mach.

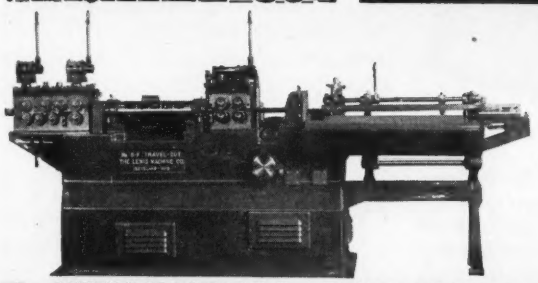


Bench Type Butt Welder

Spot Welder

CHARLES EISLER
EISLER ENGINEERING CO., 747 So. 13th St., near Avon Ave., Newark 3, N.J.

LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



for 1/16" to ¾" rod
Round
Square
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Hexagon
Ferrous and Non-Ferrous
Machines

Automatic
High Speed
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The Sign of Dependable Service:
WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

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ROOS TOOL & MANUFACTURING CO.
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ACID AND ALKALI PROOF
LININGS AND MORTARS

ACID PROOF
CONSTRUCTION

THE CEILCOTE CO.

Consulting and Research Engineers

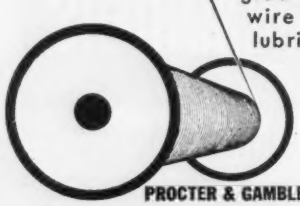
750 ROCKEFELLER BLDG.
CLEVELAND, OHIO

FOR MAXIMUM "MILEAGE" AND FINISH CONTROL IN YOUR WIRE DRAWING OPERATIONS USE P&G SOAPS

For drawing both ferrous and alloy wires—in either dry or wet operations — you can depend upon these important qualities in Procter & Gamble soaps:

Excellent Adherence
Efficient Lubrication
Minimum Dusting
Uniformity
Economy

One of our representatives will be glad to discuss wire drawing lubricants with you.

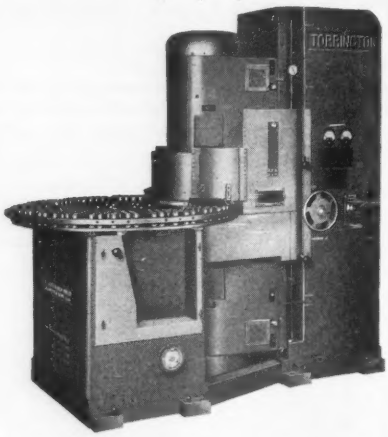


PROCTER & GAMBLE, CINCINNATI

Multiple Pass Grinding Method Originated by Torrington

GRINDING springs by means of multiple passes between the abrasive wheels, as opposed to conventional single pass grinding, is the outstanding feature of a radically new and different spring grinder just announced by **The Torrington Manufacturing Company.**

✦ ✦ ✦



BY the multiple pass method of grinding, the Company claims greatly increased accuracy, since the excess stock at each end of the spring is gently removed, a few thousandths at a time, with no burning, no burring, no deformation of the spring. "Sparking out" as each batch of springs reaches the correct dimention, a precision finish is obtained. The ground surfaces are at true right angles to the axis of the spring.

✦ ✦ ✦

ANOTHER important feature of the Torrington Spring Grinder is the fact that the grinding path passes through the center of the grinding wheels. Every spring gets exactly the same treatment, and there is no coning of the wheels, no wasted abrasive. Wheeldressing is practically eliminated.

✦ ✦ ✦

CONVENTIONAL single pass grinding may also be done on the Torrington Grinder, since its ferris wheel has two speed ranges. Production rates, under either method, are said to exceed those of other types of equipment.

✦ ✦ ✦

THE Torrington Spring Grinder is a war-time development of the

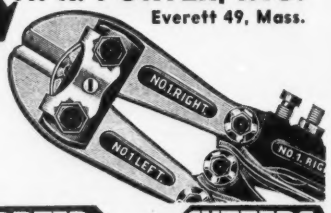
CUT HARD WIRE
The Easy Way --

including spring wire, wire fabrics, tie wire, etc., easily and quickly. Porter cutters save time and labor. Portable, hand-power — used anywhere in shop, factory, warehouse or out on a job.

There is a standard Porter tool for every cutting job. Special heads designed to fit special needs including bending, crimping, etc. Write for catalog.

**(with center cut round edge jaws)*

H. K. PORTER, INC.
Everett 49, Mass.



PORTER HKP CUTTERS

AMTHOR
STANDARD TENSILE STRENGTH TESTER

FOR LIGHT WIRE

DIAL TYPE
ELONGATION INDICATOR

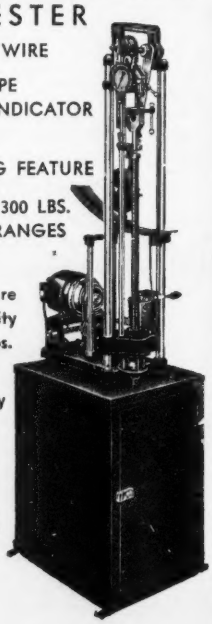
WITH FIXED
READING FEATURE

MAX. CAPACITY 300 LBS.
IN THREE SUB-RANGES

Write For Literature On Higher Capacity Tester to 1500 lbs.

"NEW Low Capacity Tester for Very Fine Wires"

All Testers Can Be Graduated in Either Metric or English System



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HOT PRESSED CARBIDES

DIES: Rough Cored
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(round and shaped)
Extrusion
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Shoulder
ALSO: Guide Rings
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For PERFECT, PRECISION-MADE, HIGH-QUALITY and UNIFORM CARBIDES

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NEW JERSEY CARBIDE DIE COMPANY
101 WILLIAMS AVENUE
JERSEY CITY 4, N. J.
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Torrington Manufacturing Company, and a number have been in constant use throughout the recent war period. Both the grinder and its radically new principle have been proved under stern conditions.

✦ ✦ ✦

National Annealing Box Company Announces New Booklet

A PICTORIAL tour of modern plant facilities, products and activities of **National Annealing Box Company, Washington, Pa.**, manufacturers of welded products from open hearth, stainless, alloy and clad steels under API, ASME, U68 and U69 codes, is graphically presented in a new brochure just released. Profusely illustrated, it clearly pictures the growth and development of "National" during the past 50 years, providing the chemical, petro-chemical, refining and steel industries with a dependable source for welded plate products.

✦ ✦ ✦

THE new booklet contains many views of National's latest type of fabricating machines used in the

ADVERTISING keeps you posted on what is new and good in machinery, equipment and supplies. It reminds you of reliable sources. Buy with confidence from the concern who ADVERTISES.

plate shop to give shape and contour to flat steel. Hydraulic and power presses are pictured in various stages of operation — forming, crimping, flanging and bending both light and heavy plate.

✦ ✦ ✦

SEVERAL pages show National Annealing Box Company's extensive facilities for producing Pressure Vessels, Galvanizing Kettles, Annealing Covers, and a wide variety of special plate work, "custom made" on a production basis. Also shown are many standard and specially designed types of equipment precision-engineered and fabricated for industry.

✦ ✦ ✦

COPIES of the new brochure may be obtained from this publication or by writing direct to National Annealing Box Company, Washington, Pennsylvania.

A Complete Line of Lubricants for Rolling Mill and Wire Mill Operations

Wire Drawing Shield

Weatherproof and Flame Resistant Finishing Compounds

Synthetic Resins

Our Research Staff Is At Your Command

THE IRONSIDES COMPANY
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Waterproof and Crepe Paper
In rolls of any size for wrapping coils and reels

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The Crepe-Kraft Company
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DIAMOND-CARBIDE
WIRE - SHAPE - TUBING
EXTRUSION - HEADING
DIES
ALSO TOOL & WEAR RESISTING PARTS
UNITED DIE CO.
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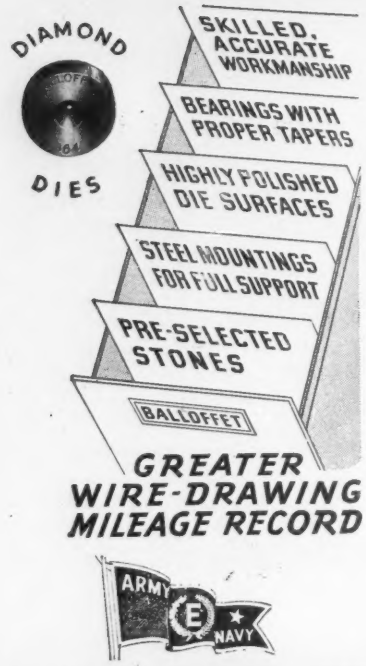

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DIES AND NOZZLE CO., Inc.
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Quality Diamond Dies Since 1870

FOR FINE WIRE DRAWING

USE WAYNE DIAMOND DIES

No matter what the metal — COPPER, BRASS, STEEL, ALLOY, TUNGSTEN, ETC. — we design and make dies that will give you the best in quality of finished wire and the longest die life obtainable.

Users of WAYNE DIES have said "They are the best value obtainable." Be sure that the trade-mark "W.W.D.Co." is on the next dies that you buy.

WAYNE WIRE DIE CO.
200 Pennsylvania Avenue
HILLSIDE, N. J.
Telephone: Elizabeth 2-456

New Super-Cutting Alloy Developed by Germans

DEVELOPMENT by the Germans of a new "super-cutting" alloy requiring no tungsten was disclosed recently by Professor Gregory Comstock, director of research at the Powder Metallurgy Laboratory, Stevens Institute of Technology.

✦ ✦ ✦

PROFESSOR Comstock, whose article on the subject has been released by the War Production Board, discovered the alloy while working as a field investigator in Germany for the Government-sponsored Technical and Industrial Intelligence Committee. He went to Germany before V-E Day.

✦ ✦ ✦

THE new cutting material, he said, consists essentially of vanadium and titaninium carbides bonded with metallic nickel.

✦ ✦ ✦

New Detroit Office for Vascoloy-Ramet

THE Detroit branch office of the **Vascoloy-Ramet Corporation** of North Chicago, Illinois, is now installed in new quarters at 512 Book Building. The move was made in order to secure more room for a branch organization expanding in step with increased deliveries and to provide a more central, downtown location.

✦ ✦ ✦

A. R. CONTI, who continues in charge of sales and service in the Detroit district, says that Vascoloy-Ramet has established the policy of carrying stocks of tools and blanks in their branches at strategic points in order to give immediate delivery on orders. In line with that policy, the Detroit branch carries a full line of standard carbide tools and blanks as well as bits, tools, cut-off blades and shell end mills of Tangtung, a special non-

DIAMOND AND CARBIDE WIRE DRAWING DIES
RUSCH WIRE DIE CORPORATION
Croton-on-Hudson, N. Y.

NOW IN STOCK
French Diamond Dies
made by
Etablissements Jos. Vianney
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Famous Wire Drawing Diamond Dies

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.0005	.0012
.00055	.0013
.0006	.0014
.00065	.0015
.0007	.0016
.00075	.002
.0008	.0022
.00085	.0024
.0009	.0026
.00095	.0028

with some intermediary sizes now on the way.

VIANNEY WIRE DIE WORKS
250 East 43rd St., New York, 17
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DIAMOND CARBIDE
DIES
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DIAMOND WIRE DRAWING DIES
LUGINBILL WIRE DIE CO.
3410 Fairfield Ft. Wayne, Ind.

Wire Drawing Diamond Dies

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WIRE DIE CORPORATION
300 W. 56th St., NEW YORK
Tel. Col. 5-1340

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CONSULTING ENGINEER
Wire Mill Equipment, Layout and Practice
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WIRE MILL CONSULTANT
FORMER PLANT MANAGER
PRACTICAL ADVICE
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SPECIALISTS IN
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CONSULTING CHEMISTS
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Complete Processing Equipment
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AUFHAUSER BROTHERS CO.
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SLEEPER & HARTLEY, Inc.
Designers and Builders
SPRING COILERS
WIRE WORKING MACHINERY
WIRE MILL EQUIPMENT
SPECIAL MACHINERY
Address Inquiries to
Box 1249
WORCESTER, MASS.

ferrous cast alloy which was developed by this company to fill the gap in cutting speeds between high speed tools and carbides.

✦ ✦ ✦

THE branch office of the **Fansteel Metallurgical Corporation,** an affiliate company, is maintained at the same address.

✦ ✦ ✦

Butt Flash Welding Machines

DEVELOPMENT of an entirely new and striking line of butt-flash welding machines in five standard sizes embodying numerous new design and operating features to provide maximum flexibility as to application, ease of maintenance and operation, safety and reliability — has been announced by **Progressive Welder Company,** 3050 E. Outer Drive, Detroit 12, Michigan. The machines range in electrical capacities from 20 KVA to 250 KVA. The five basic sizes, which comprise this range, are classified and rated according to recommended specifications of the Resistance Welder Association. The design of these machines permits them to be furnished for hand, air, hydraulic or motor operation, as desired.

STEEL WIRE
By MAURICE BONZEL
✦ ✦ ✦
Translated and Published by
Kenneth B. Lewis
Consulting Engineer
✦ ✦ ✦
Price $15.00
✦ ✦ ✦
495 pages—414 illustrations
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300 Main St. Stamford, Conn.

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• PLATING TANKS
• ANODIZE TANKS
HEATING UNITS FOR ACID TANKS
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ACID PROOF BRICK
for
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Annealing Pots and Boxes
Galvanizing Kettles
Lead and Spelter Pans
Pressure Vessels
National Annealing Box Co.
Established 1895
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Specify SAUEREISEN
ACIDPROOF CEMENTS—COMPOUNDS
FOR
Tanks, Sewers, Stacks, Floors
Technical cements for all purposes.
Send sketches or samples
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WIRE DRAWING MACHINERY
AND EQUIPMENT
Rod Frames — 16" Frames, 8" Frames — Take-Up Frames, Wire Pointers — Puller Tongs.
General and heat resisting alloy castings for wire mill use.
Circulars on Request.
E. J. SCUDDER FOUNDRY & MACHINE CO.
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EXPERT RECUTTING
DIAMOND DIES, DIAMOND POWDERS
Eastern Representative of
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ROLLING MILLS & ROLLS

Two Waterbury-Farrel Heavy Duty Rolling Mills, one over one type, eight-inch diameter, six inches wide, six-inch diameter necks, high carbon, high chrome rolls. Extra rolls also.

Two Medium Duty Rolling Mills eight-inch diameter, five-inch wide face, five-inch neck rolls. Rolls with 16-inch wide faces, some nine-inch working diameter, eight-inch diameter necks; some 10¼ working diameter eight-inch necks; some twelve-inch working diameter nine-inch necks, some with bores for water cooling.

Fine Wire Drawing Machines (Twelve Draft) in good condition. Very reasonable.

Write To

ESTEY CORPORATION

Cedar Lane

Englewood, New Jersey

FOR SALE

Morgan Connors 5 Block-6 Die Wire Drawing Machine. 16″ Blocks—last Block Double Deck—Finishing Speed 600 F. P. M.

Morgan Connors 2″ Motor Pointer for pointing wire ¾″ and smaller. Complete with Motor and Switch.

Special 8 Block Tandem Wire Drawing Machine—Tub type for drawing fine wires of all types. New Chain and Sprocket Drive between 8″ Horizontal Blocks.

Straight Roll Wire Drawing Machine—16 Dies Capacity. Equipped for 15 HP. Motor Drive. Apply Box 412, c/o WIRE & WIRE PRODUCTS

Factory Manager, Insulated Wire and Cable Plant. Good future for qualified man with small progressive company with an established reputation. State age, education, experience and references. Apply Box No. 413, c/o WIRE AND WIRE PRODUCTS.

WIRE WORKING MACHINERY

2 Morgan No. 238 Bull Blocks M.D.
1 Torrington Tandem Rolling Mill M.D.
2 Torrington No. W-24 Spring Coilers M.D.
2 Waterbury Step Cone Drawing Machines.
3 Nilson 4-slide Wire Forming Machines.
2 Shuster Shaped Wire S & C Machines.
8 Shuster Round Wire S & C Machines.

NATIONAL MACHINERY EXCHANGE
128-138 MOTT ST. NEW YORK, N. Y.

Cable Saves U.S.S. Houston

WITH her main power knocked out as the result of a torpedo hit by Japanese bombers off Formosa on October 14, 1944, the **U.S.S. Houston** was saved by a casualty power supply cable which at times carried twice the supply of electric power that it was originally intended to deliver. Supplied by the **American Steel & Wire Co.**, subsidiary of United States Steel Corp., the cable is designated as TCOP-42 and is specially designed to carry power from emergency diesel generators to certain units of the ship to permit partial operations even though the vessel may have suffered damage.

✦ ✦ ✦

IN a communication to the men and women of the Worcester, Mass., plant of the Wire Company, Vice Admiral E. L. Cochrane, chief of the Bureau of Ships of the Navy Department, credited the "exceptional serviceability" of the cable with being a "contributing factor in saving the U.S.S. Houston" after the big cruiser had been torpedoed.

✦ ✦ ✦

THE cable was produced at the Electrical Cable Works of the company. A flexible, 3-conductor cable, it is jacketed with oil-resistant synthetic rubber and has an outside diameter of 1¼ inches. Of the portable type, it can be laid anywhere desired and can be led around corners and angles, carrying power to installations in all parts of the ship.

✦ ✦ ✦

A Review of Recent Wire Patents

(Continued from page 805)

No. 2,383,927, WIRE GRINDING MACHINE, patented August 28, 1945 by Carl A. Carlson, Worcester, Mass., assignor to Norton Company, Worcester, Mass., a corporation of Massachusetts.

✦ ✦ ✦

Two grinding wheels are employed and adapted to be independently moved toward or away from the wire. There are 11 claims.

✦ ✦ ✦

FOR SALE

Quantity of Twenty-carrier Textile Bench Type Wire Braiders

Box 373 c/o
WIRE & WIRE PRODUCTS

ATTENTION
WIRE MFGS. FIRMS or INDIVIDUALS
Re-WORK WANTED
SPOOLING OF YOUR WIRE
90 HEADS ready to OPERATE at YOUR COMMAND.

Contract to spool large tonnage desired.
Capable to produce 100 Tons Monthly, .013.
Completing contract with a large supplier for U. S. Army Signal Corps of .013 Galv.
Communication Wire spooling from Coils to Metal spools 3½x6½ for Stranders.
Spooling done at low cost to you.
Will entertain any kind of work, spooling any kind or size of wire.

Write or telephone us,
JERSEY SPECIALTY CO.,
Little Falls, N. J.
All Phones, Little Falls 4-0784

Strand, Wire Rope and Cable
STEEL and COPPER
Also Signal Corps W-110-B Strand in sizes: .013 & .014 inches
The Brewer Manufacturing Co.
Muncy, Pa.

FOR SALE: Firth-Sterling and Carboloy R_2 dies used on High Carbon Steel Wire. Sizes .052″ to .068″, Casing 1½″ diamater x 9/16″. Price on application.

Union Wire Rope Corporation,
21st & Manchester Avenue,
Kansas City 3, Missouri

WANTED

Six USED Spoolers for latest type Vaughn No. 12HF Fine Wet Wire Drawing Machines.
Contact: Curtis Voigtlander,
Union Wire Rope Corporation,
21st & Manchester Avenue,
Kansas City 3, Missouri

MAGNET WIRE ENGINEER-EXECUTIVE AVAILABLE

Proven ability in Engineering, Management Costs and Sales of magnet wire production; also qualified in design and installation modern magnet wire equipment. Mechanical engineering graduate, age 40, best references. Location immaterial. Salary, $7-8,000. Address Box 410, c/o WIRE & WIRE PRODUCTS.

WANTED

Engineer and Superintendent to lay out, install, and get into production new high carbon spring wire and rolling mill in connection with plant using these materials in Chicago. Capacity, twenty tons daily. Address Box 411, c/o WIRE & WIRE PRODUCTS.

ELECTRIC WIRE SALES REPRESENTATIVES

Large Mfr. electric wire and cable is forming National and Export Sales Organization. All territories open. Commission.

WHITE ELECTRIC CABLE CO.,
HAVERSTRAW, N. Y.

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WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ACID INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

ACID-PROOF CONSTRUCTION—
Ceilcote Co., The, Cleveland, Ohio
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio
Nukem Products Co., Buffalo, N. Y.
Sauereisen Cements Co., Pittsburgh, Pa.

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio.

ALKALINE CLEANERS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.

ANNEALING MACHINES—
Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

BAKERS—Flash
Morrison Engineering Corp., Cleveland, Ohio

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Corp., Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

BELTS—Wire
Wickwire Spencer Steel Co., New York, N. Y.

BENDERS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES & SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BRICKS—Acid Proof
Keagler Brick Co., Steubenville, Ohio.
Nukem Products Co., Buffalo, N. Y.

CABLE LACQUERING OVENS
Industrial Oven Engr. Co., Cleveland, Ohio.

CABLE REEL BORERS—
Root, B. M., Co., York, Pa.

CABLE—Steel and Copper
Bethlehem Steel Co., Bethlehem, Pa.
Brewer Mfg. Co., Muncy, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Wickwire Spencer Steel Co., New York, N.Y.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

CEMENTS—Acid Proof
Sauereisen Cement Co., Pittsburgh, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.
Broden Construction Co., Cleveland, O.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Haveg Corporation, Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corp., Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

COLD HEADERS—
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds, Inc., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vianney Wire Die Wks., New York, N. Y.

DIAMOND POWDERS—
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.

DIAMOND TOOLS—
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Co., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hartley Wire Die, Thomaston, Conn.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Metal Carbides Corp., Youngstown, Ohio.
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
New Jersey Carbide Die Co., Jersey City 4, N. J.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Michigan Wire Die Co., Detroit, Mich.
New Jersey Carbide Die Co., Jersey City 4, N. J.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Tungsten Electric Corp., Union City, N. J.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Metal Carbides Corp., Youngstown, Ohio.
New Jersey Carbide Die Co., Jersey City 4, N. J.
Rusch Wire Die Corp, New York, N. Y.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Metal Carbides Corp., Youngstown, Ohio.
Michigan Wire Die Works, Detroit, Mich.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Tungsten Electric Corp., Union City, N. J.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Hubbard Spool Co., Chicago, Ill.
Stevens Metal Products Co., Niles, Ohio.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

DRYING & PRE-HEATING ROOMS
Carl-Mayer Corp., Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.

DRYING EQUIPMENT
Carl Mayer Corp., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

ENGINEERS—Consulting Wire Mill
Aufhauser Brothers Co., New York 5, N. Y.
Lewis, Kenneth B., Worcester, Mass.
Wiel, I. D., New York, N Y.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn
Entwistle, James L., Co., Pawtucket, R. I.

WHERE TO BUY, Continued

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCES AND FENCING—Wire
Wickwire Spencer Steel Co., New York, N.Y.

FIREBRICK REFRACTORIES—Brick and Cement
Babcock & Wilcox Co., The, New York, N. Y.

FLASH BAKER—
Morrison Engr. Corp., Cleveland, Ohio

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa
Parkin, Wm. M., Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Oven Engr. Co., Cleveland, Ohio.

FURNACES—Annealing
Ajax Manufacturing Co., Cleveland, Ohio
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Ajax Manufacturing Co., Cleveland, Ohio
Eisler Engineering Co., Newark 3, N. J.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Galvanizing Equipment
Electric Furnace Co., Salem, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corporation, Toledo, O.
Wilson, Lee, Engineering Corp., Cleveland, Ohio

FURNACES—Hard'ing & Temp'ing
Ajax Manufacturing Co., Cleveland, Ohio
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Manufacturing Co., Cleveland, Ohio
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Manufacturing Co., Cleveland, Ohio
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (Oil, Gas and Electric)
Ajax Manufacturing Co., Cleveland, Ohio

FURNACES—Salt Bath
Ajax Manufacturing Co., Cleveland, Ohio
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corporation, Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Meaker Co., The, Chicago, Ill.
Wilson, Lee, Engr. Co., Cleveland, Ohio

GALVANIZING KETTLES
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., Worcester, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
Industrial Oven Engr. Co., Cleveland, Ohio.

INSULATING MATERIALS—
Angier Sales Corp., Framingham, Mass.
Cheney Bros., New York, N. Y.
Crepe-Kraft Co., Newark, N. J.
Dobeckmun, The, Co., Cleveland, Ohio.
Du Pont de Nemours, E. I. & Co., Wilmington, Del.
Owen-Corning Fiberglas Corp., Toledo, Ohio
Standard Varnish Works, Staten Island, N. Y.

KETTLES—Galvanizing, Annealing, Tinning, etc.
National Annealing Box Co., Washington, Penna.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Morgan Construction Co., Worcester, Mass.
Roos, H. & G., Tool & Mfg. Co., Montclair, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry & Machine Co., Waterbury, Conn.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Ironsides Co., The, Columbus, Ohio
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable Reel Boring
Root, B. M., Co., York, Pa.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Coil Wrapping
Angier Sales Corp., Framingham, Mass.

MACHINERY—Coilers
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading with Wire Drawing Attachment
Ajax Manufacturing Co., Cleveland, Ohio

MACHINERY—Copper Wire Drawing and Rolling
American Insulating Mach'y Co., Phila., Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Cutting
Ajax Manufacturing Co., Cleveland, Ohio
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Hallden Machine Co., The, Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio.
Moslo Machinery Inc., Cleveland, Ohio.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Porter, H. K., Inc., Everett, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Die Making
Carboloy Co., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Roos, H. & G., Tool & Mfg. Co., Montclair, N. J.

MACHINERY—Draw Benches
Ajax Manufacturing Co., Cleveland, Ohio
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging
Broden Construction Co., Cleveland, Ohio.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Oven Engineering Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Fence
Broden Construction Co., Cleveland, Ohio
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark 3, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming
Eisler Engineering Co., Newark 3, N. J.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Galvanizing
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, Ohio.
Meaker Co., The, Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

WHERE TO BUY, Continued

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Material Handling
Clark Truck Tractors Div., Battle Creek, Mich.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Brockton, Mass.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Nail and Tack
Broden Construction Co., Cleveland, Ohio.
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Quill Winding
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio.
Emory, Robert J., Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark 3, N. J.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Ajax Manufacturing Co., Cleveland, Ohio
Broden Construction Co., Cleveland, Ohio.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio.
Moslo Machinery Co., Cleveland, Ohio.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Amthor Testing Instrument Co., Brooklyn, N. Y.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L., Electric Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co. Torrington, Conn.

MACHINERY—Welding Wire
Aufhauser Brothers Co., New York 5, N. Y.
Eisler Engineering Co., Newark 3, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark 3, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY — Wind-up (Constant Tension, Variable Speed
Industrial Oven Engr. Co., Cleveland, Ohio.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark 3, N. J.
Nilson, A. H., Co., Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
Ajax Manufacturing Co., Cleveland, Ohio
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Inc., Brockton, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Clark Truck Tractors Div., Battle Creek, Mich.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co, Torrington, Conn.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburg, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

OILS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Philadelphia, Pa.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, O.

OVENS—Dehydrogenizing
Carl-Mayer Corp., Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.

OVENS—Industrial
Carl Mayer Corp., The, Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, O.
Moslo Machinery Co., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAINTS—Marine
American Chemical Paint Co., Ambler, Pa.

PAINTS—Structural Steel
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

WHERE TO BUY, Continued

PAPER—Corrosion Preventive
Angier Sales Corp., Framingham, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER—Insulating
Angier Sales Corp., Framingham, Mass.
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING TANK LININGS—
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Keagler Brick Co., Steubenville, Ohio.
Sauereisen Cement Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Ceilcote, The, Co., Cleveland, Ohio
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

POTS—Lacquer
Industrial Oven Engr. Co., Cleveland, Ohio.

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Industrial Oven Engr. Co., Cleveland, O.
Moslo Machinery Co., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
J. L. Clark Mfg. Co., Rockford, Ill.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Stevens Metal Products Co., Niles, Ohio.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Wooden
Bridge Mfg. Co., Inc., The, Hazardville, Conn.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Morrison Engr. Corp., Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Spencer Steel Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLL STRAIGHTENERS—
Moslo Machinery Co., Cleveland, Ohio.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Brewer Mfg. Co., Muncy, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Heil Engineering Co., Cleveland, Ohio
Standard Industrial Compounds Co., Chicago, Ill.

SATURATION SYSTEMS—
Industrial Oven Engr. Co., Cleveland, Ohio.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Potter, Neil C., Newark, N. J.
Proctor & Gamble, Concinnati, Ohio
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Oven Engr. Co., Cleveland, Ohio.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
J. L. Clark Mfg. Co., Rockford, Ill.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
J. L. Clark Mfg. Co., Rockford, Ill.
Hayward, R. B. Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPRINGS—Steel
Wickwire Spencer Steel Co., New York, N. Y.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRAND—Steel and Copper
Brewer Mfg. Co., Muncy, Pa.
Wickwire Spencer Steel Co., New York, N. Y.

STRIP—Brass and Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Seneca Wire & Mfg. Co., Inc., Fostoria, O.
Wickwire Spencer Steel Co., New York, N.Y.

STRIP METAL TESTERS—
Scott Testers, Inc., Providence, R. I.

STRIPPERS—Compounds for Wire
Fidelity Chemical Products, Newark, N. J.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANK LININGS—Brick
Ceilcote Co., The, Cleveland, Ohio.
Keagler Brick Co., Steubenville, Ohio.
Nukem Products Corp., Buffalo, N. Y.

TANKS—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Nukem Products Corp., Buffalo, N. Y.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.
National Annealing Box Co., Washington, Pa.

TESTING INSTRUMENTS—
Amthor Testing Instrument Co., Brooklyn, N. Y.
Davis, R. L., Electric Co., Wallingford, Conn.
Scott Testers, Inc., Providence, R. I.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Clark Truck Tractor Div., Battle Creek, Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

TRAVERSES—
Hubbard Spool Co., Chicago, Ill.
Stevens Metal Products Co., Niles, Ohio

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power
Standard Machinery Co., Providence, R. I.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
Standard Varnish Works, Staten Island, N.Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark 3, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Philadelphia, Pa.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Oven Engr. Co., Cleveland, Ohio.

WHERE TO BUY, Continued

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A. Sons, Co., Trenton, N. J.
Wheeling Steel Corp., Wheeling, Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio

WIRE—Enameled for Coils
North American Philips Corp., Dobbs Ferry, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A. Sons, Co., Trenton, N. J.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio
Spencer Wire Co., West Brookfield, Mass.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Spencer Steel Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Music
American Brass Co., The, Waterbury, Conn.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio
Spencer Wire Co., West Brookfield, Mass.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

WIRE—Non-Ferrous to Specification for Special Purposes
Hudson Wire Co., Ossining, N. Y.
North American Philips Corp., Dobbs Ferry, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
American Brass Co., The, Waterbury, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio
Wickwire Spencer Steel Co., New York, N. Y.

WIRE—Stainless Steel
Firth-Sterling Steel Co., McKeesport, Pa.
Spencer Wire Co., West Brookfield, Mass.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio
Spencer Wire Co., West Brookfield, Mass.
Wheeling Steel Corp., Wheeling, N. Y.
Wickwire Bros., Inc., Cortland, N. Y.
Wickwire Spencer Steel Co., New York, N. Y.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARNS AND TAPES—
Cheney Bros., New York, N. Y.
Dobeckmun Co., The, Cleveland, Ohio
Du Pont de Nemours, E. I. & Co., Wilmington, Del.
Owens-Corning Fiberglas Corp., Toledo, O.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

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— THE MORDICA MEMORIAL LECTURE FOR 1945 —

By John C. Callaghan,
Works Manager, Canada Works,
Steel Company of Canada, Ltd., Hamilton, Ontario, Canada

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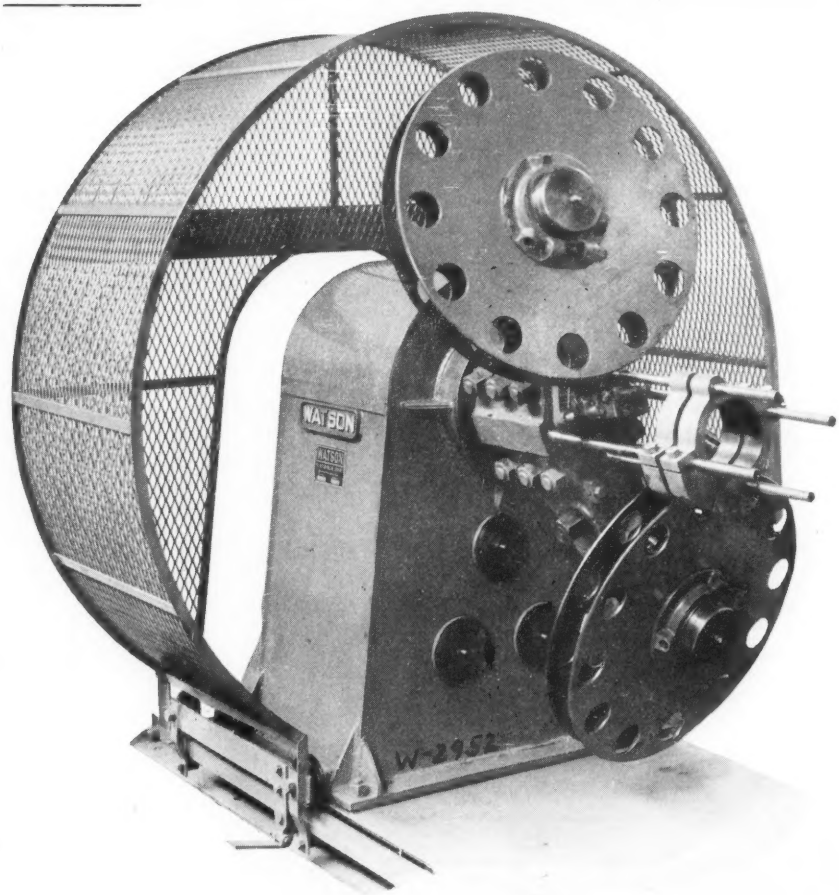

Tape Angles and Offset are rapidly adjusted and lock positively. The Head is mounted in a fully enclosed Ball Bearing Steel Drive Stand, having Speed-Change and Reverse-Gears. Heaviest Steel Construction prevails throughout.

Unit shown on cut W2952 is 40″ wide at the base and of 63″ O.A. Length. It loads pads to 28″ dia. x 2½″ width. Center bore is 5″. Gearing is for speeds from 120 to 177 RPM.

* * *

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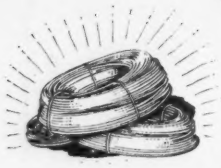

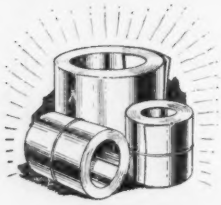

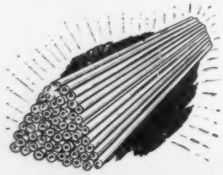

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With Heavy V-type Cast Grid Heating Elements
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Bright Anneals 2500 lbs of Copper Wire Per Hour

Bright, uniformly annealed copper wire — at the rate of 1¼ tons per hour — is discharged continuously from the above combination gas-electric, controlled atmosphere furnace. This furnace handles rod in coils up to 36″ in diameter as well as wire on large reels. The material is carried through the furnace on bulkhead type trays which provide an effective seal for the protective atmosphere used in the equipment. These trays eliminate the use of doors, lock chambers, or other sealing devices at either the charging or discharging ends of the furnace.

The heating chamber is divided into two separately and automatically controlled zones. The first or charging zone is heated by EF gas-fired recuperative type radiant tubes. The second or soaking zone is heated by heavy V-type cast alloy heating elements.

The heating elements in each zone are located above and below the charge and extend the entire width of the chambers, insuring absolute temperature uniformity throughout the charge.

The protective atmosphere is produced in an EF generator located beside the furnace.

Other outstanding EF production furnace installations include furnaces for bright annealing, both ferrous and non-ferrous strip, wire, tubing and other products - - - furnaces for the production heat treatment of bolts, springs, castings, stampings and forgings; as well as furnaces for aluminum, copper and brass brazing; billet heating, scale-free hardening and other processes.

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